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# **NAVAL POSTGRADUATE SCHOOL**

**MONTEREY, CALIFORNIA**

## **THESIS**

**CAST IRON VERSUS CREATIVITY: FOSTERING  
BALANCED THINKING IN MILITARY  
PROFESSIONALS**

by

Michael H. Laplante

June 2015

Thesis Advisor:  
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**CAST IRON VERSUS CREATIVITY: FOSTERING BALANCED THINKING IN  
MILITARY PROFESSIONALS**

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Major, Canadian Armed Forces  
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Submitted in partial fulfillment of the  
requirements for the degree of

**MASTER OF SCIENCE IN DEFENSE ANALYSIS**

from the

**NAVAL POSTGRADUATE SCHOOL  
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## **ABSTRACT**

This research explores how the framing of tasks affects an individual's psychological employment of thinking-style balance in performing those tasks. The methodology utilizes multivariant experimentation with military officers. The research analyzes the impact of how a commander frames a problem to a subordinate. More specifically, the work seeks to parse the effect of linear (analytical) framing, nonlinear (balanced) framing, or no additional frame (control). There were six key findings: military decision makers have a baseline linear thinking bias; a majority of the participants fell below the threshold for being moderately versatile thinkers; American participants had a stronger baseline linear bias than international participants; the impact of problem framing on overall thinking style was minimal; the linear treatment group experienced significantly lower emotional thinking scores; and the linear treatment group took significantly longer to complete the experiment. It was concluded that military decision makers have a strong linear bias that is not easily influenced by problem framing. It was also concluded that linear framing has a significant impact on decision-making time and emotional thinking. In an effort to reduce the military decision maker linear bias, it is recommended that professional military education include a significant increase in nonlinear thought processes, such as design thinking. It is also recommended that incentive structures be updated to create and promote an organizational culture that supports a linear/nonlinear balanced thinking approach to problem solving.



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# TABLE OF CONTENTS

<b>I. INTRODUCTION .....</b>	<b>1</b>
<b>A. BACKGROUND .....</b>	<b>1</b>
<b>B. RESEARCH QUESTION .....</b>	<b>4</b>
<b>II. THEORY .....</b>	<b>7</b>
<b>A. LINEAR AND NONLINEAR THINKING .....</b>	<b>7</b>
<b>B. STRATEGIC THINKING AND CREATIVITY .....</b>	<b>10</b>
<b>C. COGNITIVE AND PSYCHOLOGICAL ASPECTS OF THINKING.....</b>	<b>12</b>
<b>D. EXPERIMENTATION .....</b>	<b>13</b>
<b>E. THE LINEAR THINKING VICIOUS CYCLE.....</b>	<b>14</b>
<b>III. METHODOLOGY .....</b>	<b>19</b>
<b>A. GENERAL .....</b>	<b>19</b>
<b>B. PARTICIPANTS.....</b>	<b>19</b>
<b>C. EXPERIMENTAL DESIGN.....</b>	<b>20</b>
<b>D. EXPLANATION OF HYPOTHESES .....</b>	<b>23</b>
<b>1. Explanation of Hypothesis One .....</b>	<b>23</b>
<b>2. Explanation of Hypothesis Two.....</b>	<b>24</b>
<b>3. Explanation of Hypothesis Three .....</b>	<b>25</b>
<b>IV. DATA AND DATA ANALYSIS .....</b>	<b>27</b>
<b>A. GENERAL .....</b>	<b>27</b>
<b>B. PRE-VIGNETTE DATA.....</b>	<b>27</b>
<b>C. POST-VIGNETTE DATA .....</b>	<b>29</b>
<b>V. DISCUSSION.....</b>	<b>33</b>
<b>A. FINDINGS.....</b>	<b>33</b>
<b>B. BASELINE THINKING STYLE DISCUSSION .....</b>	<b>34</b>
<b>C. POST-VIGNETTE THINKING STYLE DISCUSSION .....</b>	<b>38</b>
<b>VI. RECOMMENDATIONS .....</b>	<b>43</b>
<b>APPENDIX A. IRB APPLICATION .....</b>	<b>47</b>
<b>APPENDIX B. RECRUITMENT EMAIL .....</b>	<b>57</b>
<b>APPENDIX C. CONSENT FORM .....</b>	<b>59</b>
<b>APPENDIX D. LNMTSA .....</b>	<b>61</b>
<b>APPENDIX E. EXPERIMENT VIGNETTE .....</b>	<b>67</b>
<b>APPENDIX F. EXPERIMENT TREATMENTS .....</b>	<b>69</b>
<b>A. CONTROL GROUP COMMANDER'S GUIDANCE.....</b>	<b>69</b>
<b>B. LINEAR GROUP COMMANDER'S GUIDANCE .....</b>	<b>69</b>
<b>C. BALANCED GROUP COMMANDER'S GUIDANCE.....</b>	<b>69</b>
<b>APPENDIX G. DEBRIEF SCRIPT .....</b>	<b>71</b>

<b>LIST OF REFERENCES .....</b>	<b>73</b>
<b>INITIAL DISTRIBUTION LIST .....</b>	<b>77</b>

## LIST OF FIGURES

Figure 1.	Causal Loop Diagram (CLD).....	15
Figure 2.	Research Methodology .....	23

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## LIST OF TABLES

Table 1.	Average Baseline Thinking Style Scores.....	28
Table 2.	Linear Score for U.S. Versus Non-U.S. Participants.....	29
Table 3.	Average Changes in Linear and Nonlinear Thinking Post-Vignette .....	30
Table 4.	Linear Treatment and Emotional Thinking.....	31
Table 5.	Linear Group and Time Taken to Complete Experiment .....	32

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## **LIST OF ACRONYMS AND ABBREVIATIONS**

CFPAS	Canadian Forces Personnel Appraisal System
LNMTSA	Linear/Nonlinear Multidimensional Thinking Style Assessment
MDMP	Military Decision Making Process
OODA	Observe Orient Decide Act
OPP	Operational Planning Process
PME	Professional Military Education
PSO	Personnel Selection Officer
TDO	Training and Development Officer



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# **I. INTRODUCTION**

## **A. BACKGROUND**

The aim of this thesis is to identify the degree to which problem framing affects an individual's decision-making approach and thinking style. *Problem framing* is the conceptual interpretation of a problem, and serves to set boundaries for decision makers (Dzbor & Zdrahal, 2002). In a military context, "the art of framing the problem is the art of seeing the essential and relevant among the trivial and irrelevant" (Clark & Blew, 2008, p. 1). The problem framing studied in this research refers to a superior's definition of a problem to a subordinate. This form of framing is typically delivered through the commander's guidance, providing the subordinate with an initial conceptual understanding of the problem space. Moreover, the commander's guidance has the potential to influence a subordinate's cognitive thought process when solving the problem, impacting the subordinate's use of linear and nonlinear thinking styles.

Particularly in the military, there is a heavy emphasis on linear thinking and a professional culture that fosters a quantitative and predictive worldview (Schmidt, 2013). For example, in the United States military, there is an overwhelming emphasis on immediate tactical success versus long-term effects (Bethel, 2013). Linear thinkers with a tactical focus are prone to oversimplify problems by holding many things constant by assumption. While this approach may yield tactical victory, it fails to address more fundamental factors that may have a strategic impact beyond the tactical problem. Standard officer education reflects this shortsightedness, where little emphasis is placed on developing nonlinear thinking skills. Current Officer Efficiency Reports used by the U.S. Army promote conformity and fail to recognize the importance of strategic thinking (Laich & Young, 2011; Wolters, Grome, & Hinds, 2013, p. 2). I have found that Personnel Evaluation Reports used by the Canadian Armed Forces suffer the same shortcomings and incentivize conformity and linear thought over nonlinear thinking characteristics. Nonlinear thinkers allow for more foundational assumptions to be

critically analyzed, which in turn promotes situational awareness that extends beyond the tactical level, ultimately improving strategic thought.

The preponderance of linear thinking in contemporary militaries is profound. As pointed out by Arquilla (2008, p. xi), the uncompromising adherence to a philosophy of overwhelming force has blurred the perception of twenty-first century warfare. While this misperception is largely attributed to an inherent resistance to organizational change (Arquilla, 2008; Gartner, 1997, p. 23), the failure to alter strategic policy is also a function of a military culture that lacks creativity and nonlinear thought and thus fails to change strategic thinking. In a speech on military transformation shortly after the September 11 attacks, Defense Secretary Donald Rumsfeld called for a need to think creatively in an effort to prepare for new challenges (Shanker, 2002). Both Rumsfeld and Arquilla (2008) are critical of military trends that time and time again display an aptitude for emulating the past, rather than preparing for the future. This thesis reaffirms those ideas by arguing that a deficiency in nonlinear thinking is a root cause of this phenomenon.

Many have identified the potential benefits of nonlinear thinking in the military (Beyerchen, 1992; Bousquet, 2009; Boyd, 1996; Spinney, 2005; Spinney, 1999). Nonlinear thinking is highly influential to successful innovation, particularly in developing new doctrine; network-centric warfare and swarming are recent prominent examples (Bousquet, 2009). Furthermore, Bousquet and others, such as Spinney (2005), highlight how military organizations can even turn highly effective nonlinear processes into nonadaptive organizational paradigms. For instance, Boyd's (1996) Observe–Orient–Decide–Act (OODA) loop is widely acclaimed throughout the U.S. military (Bousquet, 2009), and I have found that phrases such as “you need to get inside your enemy's OODA loop” are commonplace in the military lexicon. While seemingly linear and analytical on the surface, the OODA loop is actually a highly nonlinear co-evolutionary process (Spinney, 1999). A collaborator of Boyd, Spinney (2005) offers this insightful description of how modern militaries misconstrue the OODA loop:

The most dangerous internal state of an OODA loop occurs when the Orientation process becomes so powerful that it force fits the organism's observations into fitting a preconceived template, even when those observations threaten the relevance of that template. (p. 1)

Simply put, the default linear thinking approach is applied to the nonlinear and unpredictable OODA loop concept, ultimately reducing the powerful potential of the OODA decision-making cycle.

Given the current trends of chaos, uncertainty, and complexity facing modern militaries, there is an unprecedented need to adopt a dualistic linear/nonlinear thinking approach (Vance, 2013). Current professional military education does not emphasize nonlinear thinking skills such as flexibility, innovation, and entrepreneurship to exploit effectively the tools of the revolution in military affairs. Particularly when forced to make rapid decisions with imperfect information, military personnel who rely solely on traditional linear thinking approaches may not compete effectively against an opponent who employs alternative nonlinear decision-making tools such as intuition, emotion, imagination, and creativity (Vance, 2013).

Nonlinear thinking represents a mix of critical ways to approach a problem. All too often, nonlinear thinking is reduced to creativity, but current literature explains seven unique components: intuition, insight, creativity, flexibility, imagination, emotion, and values (Vance, 2013, p. 207). A balance between these nonlinear thinking traits and traditional linear thought is a key component when facing the nonlinear threats of the future. The term *thinking style balance* is used throughout the thesis. Thinking style refers to an individual's predominant pattern when perceiving, understanding, and solving problems (Vance, 2013, p. 205). For this study, thinking style balance refers to an individual's use of two styles of thinking: linear and nonlinear. The balance reflects where a decision maker is on a spectrum of linear and nonlinear thought when solving a problem. This is discussed in detail in Chapters III and IV.

The thesis proceeds as follows. Chapter II outlines recent literature on linear and nonlinear thinking, strategic thinking and creativity, cognitive and psychological aspects of thinking, and experimentation. Chapter III then discusses the thesis methodology and

provides a brief overview of the experiment. Chapter IV presents the data, and highlights the key findings from the data analysis. Chapter V discusses the six key findings of the experiment and relates them to current literature. Chapter VI presents the conclusion and recommendations for future research.

## **B. RESEARCH QUESTION**

The research conducted here explores how the framing of tasks affects an individual's psychological employment of thinking style balance in performing those tasks. More specifically, the following three hypotheses are experimentally tested to answer this research question.

- (1) Hypothesis One: Military decision makers have a baseline thinking style that favors linear thinking over nonlinear thinking.

Hypothesis One suggests that linear thinking is fostered, reinforced, and rewarded as soldiers progress through their careers. As a result of a constant exposure to linear thinking, it is hypothesized that military decision makers develop a baseline thinking style that is biased toward linear over nonlinear thinking. While any military decision maker retains freedom of thought and an ability to choose his thinking style when problem solving, it is hypothesized that the impact of professional military education (PME), military culture, and organizational norms heavily influence one's thought processes.

- (2) Hypothesis Two: The way a problem is framed affects the thinking style balance employed by the military decision maker.

Hypothesis Two suggests that the simple framing of the problem has a significant impact on the thinking style balance employed by the decision maker. If a commander stresses step-by-step doctrinal procedures and prescriptive analytical processes, it is hypothesized that the subordinate will favor linear thinking when problem solving. If, on the other hand, the commander provides latitude and promotes collaboration, imagination, creativity, and other nonlinear traits, it is hypothesized that the subordinate will employ a balanced, or more nonlinear, thinking style.

- (3) Hypothesis Three: When a decision maker is given linear guidance, they take longer to solve a problem than if given nonlinear guidance.

The third hypothesis suggests that linear thinking—as a result of linear guidance—results in more time taken to solve a problem. The premise of this hypothesis is that problem solvers become more concerned with the linear process they are directed to follow, rather than focusing on developing a quality solution. It can be argued that in highly stressful situations such as combat, linear thinking—in the form of well-rehearsed drills and standard operating procedures—could indeed be the preferred course of action. The issue, however, is that this mindset can be carried into less stressful situations where quick linear thought may not be optimal.

This research has direct and actionable benefits to the military. If Hypothesis One is supported by the results, PME can be adjusted to create a more balanced thinking style in military decision makers. It is important to note, however, that the only way to correct this shortfall would be through a dedicated and focused shift in current training and development practices. Officers could potentially benefit from exposure to nonlinear thinking from the very start of their careers. It is important to gain an early understanding of the benefits of nonlinear thinking, especially with respect to strategic thought and innovation. The goal is not to focus on nonlinear thinking exclusively; rather, it is to shift thinking style balance away from linearity towards the center. If Hypothesis Two is supported, military leaders can frame problems in a manner that promotes a balanced thinking style. Such a shift in problem framing requires leaders who understand the value of balanced thinking and are catalysts for change. With a focus on shifting PME, military organizations can begin to create the type of thinking warriors and organizational cultures that will guide the way forward for balanced thinking. If Hypothesis Three is supported, it will provide further incentive to introduce nonlinear thinking into PME and military culture in an effort to improve both decision-making quality and speed.



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## **II. THEORY**

### **A. LINEAR AND NONLINEAR THINKING**

A balanced approach between linear and nonlinear thinking provides a “powerful synergy” toward optimal military strategic thinking and decision making (Vance, 2013, p. 205; Schmidt, 2013, p. 220). The military profession stresses linear thought and a quantitative approach to problem solving; however, nonlinear thinking and qualitative methods are equally important to the military decision maker (Bousquet, 2009; Boyd, 1996; Beyerchen, 1992; Spinney, 2005; Spinney, 1999; Wolters et al., 2013). Unfortunately current professional military education doctrine fails to strike a balance between linear and nonlinear thinking, favoring the former throughout a military career. As a starting point, it is important to provide benchmark definitions for both linear and nonlinear thinking:

Linear Thinking: Thoughts progressing in an orderly, logical line or direction, inferred from prior thoughts, and based on tangible or observable data. Common terms for this thinking orientation include analysis, logic, reason, and inference.

Nonlinear Thinking: A process that can generate a vision of what is possible beyond the traditional way of doing things that otherwise restrain or “box in” our alternatives. The nonlinear thinking orientation is qualitative and holistic. (Vance, 2013, pp. 205–207)

The strength of this nonlinear thinking definition is that it is grounded in seven distinct thinking styles that have been identified as key dimensions to nonlinear thought: intuition, insight, creativity, flexibility, imagination, emotion, and values (Vance, 2013, p. 207). Furthermore, the same literature identifies a means of measuring an individual’s linear and nonlinear thinking style, referred to as the Linear/Nonlinear Multidimensional Thinking Style Assessment (LNMTSA; Vance, 2013). This profile assessment is used for part of the experiment in this thesis, providing insight for Hypotheses One and Two. This is further discussed in Chapter III.

The military is hungry for strategic thinkers, and professional military education should foster the necessary skills in flexibility, innovation, and entrepreneurship that support strategic thought in current and future leaders (Vance, 2013, p. 203). Sometimes referred to as the *age of science*, there is a tendency—especially within the military—to tackle all problems with a systematic linear approach (Conklin, 1996). As a matter of fact, both U.S. and Canadian professional military education is focused exclusively on linear approaches to problem solving—the military decision-making process (MDMP) and operational planning process (OPP), respectively. Recent literature points to a realization that these dogmatic processes are stifling creativity and resulting in suboptimal decision making (Runyon, 2004).

This chapter begins with an explanation of linear and nonlinear thinking. These labels are often used without clear definition, and literature from Vance (2013) clarifies the terms for this thesis. A key argument for bolstering military nonlinear thinking is the important role it plays in strategic thought. The next section explains strategic thinking and creativity, with a focus on differentiating between strategy, strategic planning, and true strategic thought. The third section presents recent literature on cognitive and psychological aspects of thinking, with a focus on the pitfalls for the military decision maker. The final section introduces the merits of experimentation as a research methodology.

The necessity for nonlinear thinking to deal with the complexity of warfare dates all the way back to Sun Tzu, the Byzantine Army, and Clausewitz. In stark contrast to the contemporary philosophy of overwhelming force, all three of these examples demonstrate the importance of nonlinear thinking in warfare. Sun Tzu's (500 BCE/1963) ideas on deception, subduing the enemy without fighting, and out-maneuvering an adversary (physically and psychologically) are nonlinear concepts that have remained highly relevant for well over two thousand years. Likewise, the Byzantine Strategikon (Maurice, 580–610/1984) spoke of doctrinal innovation with the combination of horse archers and lancers to bring an unprecedented level of fire and shock to the enemy. In addition, the

Byzantine's abilities to learn from their enemies and apply an economy of force philosophy were nonlinear concepts that were key to their success (Petersen, 1992).

Clausewitz also highlighted the importance of nonlinear thought; however, the overwhelming linear approach employed in military analysis has resulted in a failure to effectively address the intended meaning of *ends-ways-means* (Beyerchen, 1992). The true nonlinear conception "is that the conduct of any war affects its character, and its altered character feeds back into the political ends that guide its content" (Beyerchen, 1992, pp. 68–69). The remarkable trinity (von Clausewitz, 1832/1976) between violence, hatred, and enmity; uncertainty, chance, and probability; and political purpose is another Clausewitzian metaphor that has been attenuated due to a linear view on a nonlinear concept (Beyerchen, 1992, p. 69). A retraining of our intuition is recommended with an emphasis on nonlinear thinking. "The overall pattern is clear: war seen as a nonlinear phenomenon—as Clausewitz sees it—is inherently unpredictable by analytical means" (Beyerchen, 1992, p. 90). In the same light, additional literature suggests that the qualitative approach is a fundamental aspect of strategic thought. Military culture conflates strategic thought with a flawed quantitative approach (Schmidt, 2013). To further compound the problem, inward-looking strategic thinking that questions the military's approach to problem solving is suppressed, leaving a system that promotes quantitative linear thought (Schmidt, 2013).

Studies of military decision making (Klein, 1989; Posen, 1984; Snyder, 1984, 1985; Van Evera, 1984; Van Riper, 2013) often claim that military organizations employ suboptimal decision-making. In regard to linear thinking, critics of the military tend to make two central claims. First, military organizations have a strong focus on linear rather than nonlinear thinking. This dominating characteristic is introduced in professional military education, reinforced in the military work environment, and rarely questioned or challenged. The military incentive system is geared towards rewarding individuals who adhere to standard analytical processes. These rewards are often in the form of courses required for career advancement, which serve to further promote linear thinking

processes. Moreover, this linear thought favors offensive action and results in a failure to learn from past experiences (Posen, 1984).

A second criticism of military decision making made by critics is that a focus on linear thinking subsequently inhibits innovative and strategic thought. The military culture is indeed caught in a paradox. While there is apparently a need for military strategic thinkers, it is the intrinsic cultural bias toward linear thinking that is inhibiting strategic thought and optimum decision-making.

## **B. STRATEGIC THINKING AND CREATIVITY**

A clear definition of strategic thinking is required in order to provide context for the research question. The difference between strategy and strategic thinking is also presented. As a concept, *strategy* is surprisingly hard to define, characterized as a process of adaptation in a world of uncertainty and ambiguity (Murray & Grimsley, 1994, p. 1). In another light, strategy can be described as the art that bridges the gap between knowledge and experience, allowing the strategist to apply knowledge into action and action into knowledge (Greene, 2006, p. xxii). In a specific military Clausewitzian context of *ends–ways–means*, strategy is “the direction and use made of means by chosen ways in order to achieve desired ends” (Gray, 2010, p. 18). Despite the wide scope of definitions, strategy is not synonymous with, or indicative of, strategic thinking (Van Riper, 2013). Furthermore, the definition of strategic thinking is equally broad and open to interpretation. The following definition of military strategic thinking provides a baseline for this research:

Strategic thinking employs a leader’s wisdom—gained through experience and education—to:

- Assist in selecting the ways and means needed to support the achievement of national policy goals (ends); select the military strategy, that is, the ways and means required to accomplish the goals (ends) of national security strategy; and plan for and execute campaigns and operations that advance that strategy.
- Uncover or discern the logic that holds together seemingly intractable and ill-defined problems and develop a counter-logic that resolves them. (Van Riper, 2013, p. 16)

The strength of this definition is the scope. Rather than simply focusing on strategic thinking as a means of exercising strategy, the second sub-bullet opens the definition to a wide range of questions encountered by the military decision maker.

It is also important to distinguish between strategic planning and strategic thinking, as these terms are all too often confused. Strategic planning is simply an analytical process that programs already identified strategies (Mintzberg, 1994). Strategic thinking, however, is a “synthesizing process, utilizing intuition and creativity” (Liedtka, 1998, p. 121). Furthermore, strategic planning and strategic thinking are incompatible, drawing a dichotomy between analytical problem solving and creativity in strategy-making (Liedtka, 1998, p. 121). This brings up an interesting paradox. Strategic planning is a necessary exercise in any military enterprise and is viewed as an analytical process. On the other hand, strategic thinking is anything but a solely analytical exercise. Given the inherent incompatibility between strategic planning and strategic thinking, the two undermine rather than complement one another.

Creativity is a core component of strategic thinking; however, there is little literature that goes beyond the scope of the individual creative genius (Sanders, 2013). Of particular interest to this thesis are the conceptual blocks and organizational culture aspects that affect creativity and other elements of nonlinear thinking. There are so-called *blocks* to creativity that come in forms that are perceptual, emotional, cultural, environmental, intellectual, and expressive (Adams, 2001). The research focus on linear versus nonlinear thinking is centered on intellectual blocks, while the military component of the question touches on cultural, environmental, emotional, expressive, and perceptual blocks.

Individual creativity represents a four-layer framework that encompasses cognition, emotion, the person as a whole, and the environment (Sanders, 2013). While each layer of the framework has significant implications on creativity, this thesis focuses on the cognition aspect, specifically the structure of thinking—linear versus nonlinear. It is important to note, however, that the other layers of the framework have profound impacts on the SOF decision maker’s thinking structure. For instance, there are

organizational culture aspects of the SOF enterprise that may influence the type of thinking that predominates the working environment. The military incentive structure—requirements for promotion, for example—may also stimulate aspects of the emotional framework that impact how an individual thinks. The point to note is that even with a focus on linear and nonlinear thinking, creativity and the other components of nonlinear thinking cannot be viewed in an isolated cognitive framework.

### **C. COGNITIVE AND PSYCHOLOGICAL ASPECTS OF THINKING**

Recent literature on human cognition identifies two systems of thinking—System 1 and System 2—also referred to as fast and slow thinking, respectively (Kahneman, 2011). A third system of thinking is also discussed in the literature, referring to operational design and wicked problem territory (Roberts, 2000; Van Riper, 2013). Of particular interest is the complexity of intuitive and unconscious processes, and how they subsequently relate to the heuristics and biases of judgment. A key weakness of System 1 is an inability to think statistically. The challenges posed by this weakness are “excessive confidence in what we believe we know, and our apparent inability to acknowledge the full extent of our ignorance and the uncertainty of the world we live in” (Kahneman, 2011, p. 14). Such a weakness should be of grave concern to the SOF decision maker, and is directly related to linear and nonlinear thinking.

In their seminal work on decision-making, Kahneman and Tversky (1974) assert, “people rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgment operations” (p. 1). While these heuristics can indeed simplify decision-making, they can also lead to systematic errors (Kahneman & Tversky, 1974, p. 1). There are three identified heuristics that influence the decision maker: representativeness, availability, and adjustment and anchoring (Kahneman & Tversky, 1974). While the heuristics—and the subsequent biases they promulgate—can offer convenience and efficiency to the decision maker, they also lead to systematic and predictable errors.

In addition, there are both normative and descriptive aspects of decision making (Kahneman & Tversky, 1983). This is especially important to this thesis; normative analysis addresses rationality and logic (linear thinking), whereas descriptive analysis focuses on beliefs and preferences as they actually are (Kahneman & Tversky, 1983). This contrast between normative and descriptive aspects of decision making is essential to the analysis of the SOF decision maker. Specifically, Kahneman and Tversky (1983) explain the framing of outcomes. They reveal that when a problem is viewed in a losses frame, decision makers are more risk seeking. Conversely, when presented in a gains frame, decision makers are more risk averse (Kahneman & Tversky, 1983).

While this thesis is not focused on the cognitive aspects of the brain that influence how we think, it is important to have a basic understanding of the cognitive literature, particularly the three systems of thinking. Of particular importance to this research thesis is the fact that “prolonged practice” and “skill” are also critical ingredients of intuition, offering a more holistic view of what forms intuitive judgment (Kahneman, 2011). The ramifications of the role of intuition to both linear and nonlinear thinking are discussed in greater detail in this thesis.

#### **D. EXPERIMENTATION**

The research guiding this thesis explores how the framing of tasks affects an individual’s psychological employment of thinking style balance in performing those tasks. This question is particularly suited to experimental methods. The strengths of these methods are described as follows:

The primary advantage of experiments is that they offer unparalleled control over the variables of interest. This is because the experimental method permits the systematic manipulation of variables in a controlled environment with randomly assigned subjects. Experiments thus offer the highest degree of internal validity; experimenters can be pretty confident that outcomes differ on the basis of the variables manipulated systematically within the experimental conditions. (McDermott, 2002, p. 56)



An experiment is the preferred mechanism to study the dependent variable in this thesis: the thinking style balance of the military problem solver. The experiment is aimed at identifying whether the way a problem is framed affects an individual's psychological perception of thinking style balance.

If militaries aim to increase strategic thinking abilities within their respective organizations, it is important to understand what independent variables impact strategic thought and thinking style balance. Within the military, this is a relatively young field of research. Commanders know that they want strategic thinkers, but little has been done to foster the necessary skills within the existing PME framework. Given the military preference for linear thinking and analytical problem solving, identifying how problem framing impacts thinking style balance is the first step towards an improved PME system to meet the needs of future commanders.

## **E. THE LINEAR THINKING VICIOUS CYCLE**

There is a vicious cycle that promulgates military linear thinking that requires further explanation. The apparent lack of balanced thinking in the military, and the subsequent deficiency in strategic thought, can be classified as a *wicked problem*. First and foremost, there is no definitive formulation of the problem itself—a key tenet of a wicked problem (Rittel & Webber, 1973). In fact, a clear and concise formulation of the problem is essentially, *the problem*. It is assumed that there is indeed a deficiency in military strategic thinking, but what exactly does this entail? Is the military organization equipped and organized to facilitate strategic thought? Are the individual decision makers selected, trained, and encouraged to think strategically? Does the organizational culture foster and value an environment that is conducive to thinking strategically? It is quickly apparent that any discussion of strategic thinking has numerous facets, including, but not limited to, personnel selection, organizational culture, cognitive abilities, risk aversion, incentive structures, working environment, and workload. This thesis is not an in-depth analysis of how to solve this problem; rather, it focuses on understanding the nuances of linear and nonlinear thinking in military officers. Gaining insight into current

trends in thinking style balance is the first step to developing actionable courses of action to improve strategic thinking.

The problem space is best explained using a causal loop diagram (CLD). Figure 1 presents the cycle in the form of a complex adaptive system formed by three reinforcing loops. The primary loop is R1, while R2 and R3 reinforce key variables. Since a key issue is hypothesized to be an over-focus on linear thinking, the starting point of the narrative is “level of linear thinking.” Each arrow in the CLD is annotated with either an “s” or an “o.” The “s” designation means that as the first entity moves in one direction, the second entity connected by the arrow changes in the same direction (i.e., both increase). The “o” designation means that they move in opposite directions (i.e., as one increases, the other decreases).

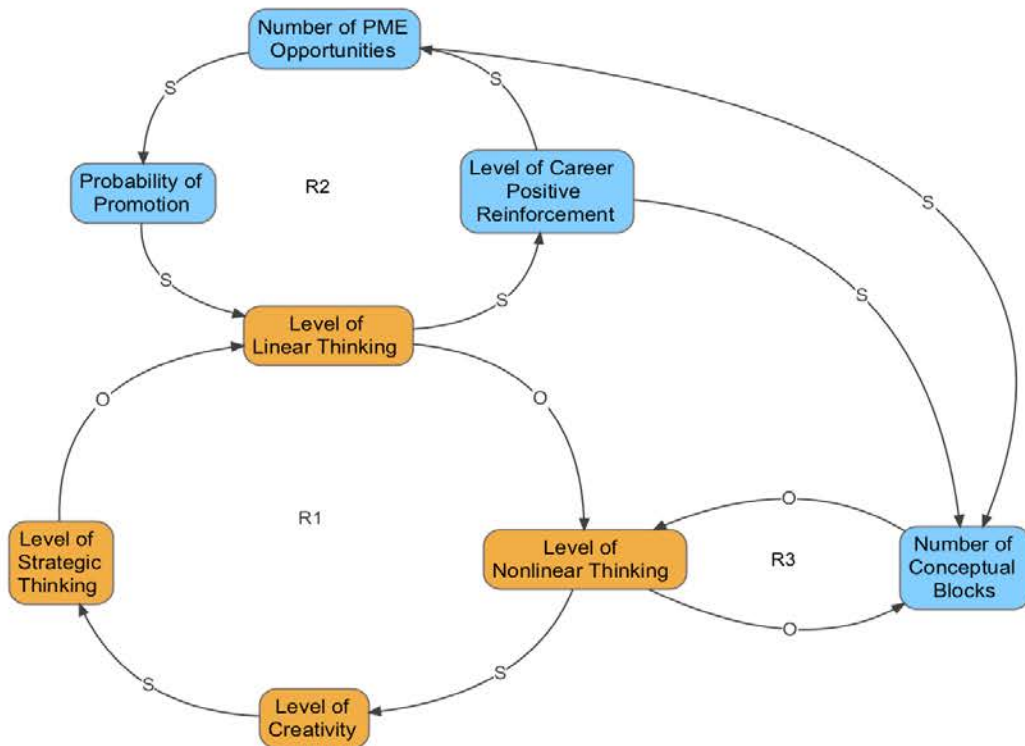


Figure 1. Causal Loop Diagram (CLD)

Referring to R1 within Figure 2, as the level of linear thinking increases, the level of nonlinear thinking decreases. This is due to the balance of individual linear and nonlinear thinking abilities (Vance, 2013). As described by Adams (2001), a common intellectual block is the choice of problem-solving language. As an officer increases his reliance on linear thinking and analytical problem solving, he subsequently reduces his reliance and openness to nonlinear thinking. As the level of nonlinear thinking decreases, an officer's level of creativity also decreases. Creativity is both a result of nonlinear thinking and a requirement for strategic thought (Sanders, 2013). As the level of creativity decreases, the level of strategic thinking also decreases. Finally, as the level of strategic thinking decreases, the level of linear thinking further increases, thereby reinforcing the R1 loop. It is important to view the R1 loop at the individual officer's cognition level. This model attempts to describe how the brain of the officer approaches problem solving, ultimately leading to increased linear thinking and decreased strategic thinking.

The important question to address is, why is the level of linear thinking increasing to set off the R1 loop? Part of the answer is explained by the loop depicted as R2. As the level of linear thinking increases, the level of career-positive reinforcement increases. The reason for this is that junior officers are primarily assessed on their abilities to apply the linear thinking promulgated by their early military education and training. As an officer completes more PME, he is ranked higher among his peers, which directly corresponds to an increase in probability of promotion. As a result of being promoted, the officer continues to emphasize the performance that led to his success; therefore, the level of linear thinking further increases. It becomes obvious that the R2 loop is directly reinforcing an increase in the level of linear thinking, which in turn drives R1. While the R1 loop focuses on individual officer cognition, the R2 loop describes the typical incentive structure in military organizations. An increased level of linear thinking inherently links the two loops.

Another variable in R1 that is influenced by an additional loop is the level of nonlinear thinking. As described in R3, as the level of nonlinear thinking decreases, the

number of conceptual blocks experienced by the officer increases. As these conceptual blocks increase, the level of nonlinear thinking further decreases. The number of conceptual blocks (in R3) is also influenced by R2. As the level of career positive reinforcement and number of PME opportunities increases, the number of conceptual blocks also increases. This can be attributed to officers being reinforced by incentives following their application of linear thinking skills. As officers are rewarded for their linear thinking, they reproduce their behavior and focus even more on linear thinking. This, in turn, increases conceptual blocks as described by Adams (2001). This increase in conceptual blocks further decreases the level of nonlinear thinking, fortifying the vicious cycle in R1.

This causal loop diagram does not propose that linear thinking is completely endemic throughout the military. It simply attempts to identify a relationship between military thinking, PME opportunities, and incentive structures. If the findings do indicate a higher-than-optimal level of linear thinking in military offices, such a model could serve as a start state for identifying intervention points.

The theory presented in Chapter II provides the building blocks for the methodology and thesis hypotheses. Following Chapter II's definition of both linear and nonlinear thinking, and an explanation of the importance of thinking style balance in strategic thought, Chapter III explains the methodology used for the thesis.

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### **III. METHODOLOGY**

#### **A. GENERAL**

This chapter explains the experimental methodology used in this thesis. The methodology builds on previous research by Vance (2013) and utilizes the Linear/Nonlinear Multidimensional Thinking Style Assessment (LNMTSA). The overall experiment sequence is presented, followed by the vignette and three treatments. Each of the three hypotheses are then discussed in greater detail. Appendix B outlines the detailed experiment, including the questions used for the LNMTSA (Vance, 2013).

#### **B. PARTICIPANTS**

Before discussing the methodology, it is necessary to explain the participants for the experiment. In accordance with the approved Naval Postgraduate School (NPS) Institutional Review Board (IRB) application (Appendix A), participants were recruited from the NPS student body via email. All participants were volunteers, with no incentives offered for participation. It is important to note that the participants are not a typical cross section of the military population. First and foremost, all participants were O-3 or O-4 rank. While employment may differ between nations and services, these officers are typically post-sub-unit command. This means that they have commanded one level below unit command (e.g., a company or squadron). Furthermore, the officers in the experiment are a diverse group from around the world, with 76% being members of the U.S. Military and 24% being military members from nations other than the United States. While the multinational makeup of the participants was not a goal of the experiment, this independent variable (nationality) offers a unique look into baseline thinking styles across borders. Finally, all participants are enrolled in a postgraduate degree program at NPS. Although application criteria can once again vary by country and service, the selection for these positions is typically competitive and focused on top performers in their respective fields. It is, therefore, reasonable to consider that the participants are a self-selected nonrandom sample that may differ significantly from the broader population of thinkers in the military profession. At the very least, the participants are considered to

have “above average” potential for employment at higher ranks; otherwise, they would not be selected for postgraduate studies.

### **C. EXPERIMENTAL DESIGN**

The thesis methodology utilizes multivariant experimentation as depicted in Figure 2. The treatment represents a commander framing a problem to a subordinate by giving specific commander’s guidance on his intent. The independent variable is the treatment: the variation in the way the problem is framed. The three conditions include linear (analytical), nonlinear (balanced), or control (no extra frame). The dependent variables are the linear/nonlinear thinking style balance, linear/nonlinear component self-assessment scores, and time taken to complete the experiment. Officers begin by completing 24 of the 48 questions from the Linear/Nonlinear Multidimensional Thinking Style Assessment (LNMTSA; Vance, 2013). This self-assessment diagnostic tool aims to identify an individual’s degree of overall thinking style balance prior to any treatment. This tool also provides a score for each of the seven components of nonlinear thinking: intuition, insights, creativity, flexibility, imagination, emotion, and values (Vance, 2013, p. 207). Treatment groups are randomly divided into three comparably sized groups: linear, balanced, and a control.

All three groups are presented with the same problem-solving vignette (shown in the following section). Officers are directed to solve the problem in accordance with the commander’s guidance provided in the treatment. The intent is for the officers to reflect on the treatment and apply the commander’s guidance to their problem-solving approach. The aim of this step is to reinforce the respective treatments. Officers are then asked to provide an overview of how they would choose to solve the problem, without any constraints or requirements.

The linear group receives linear guidance, focused on completing the task in a very logical and straightforward manner. The balanced group receives guidance that focuses on a balanced design approach, stressing several components of nonlinear thinking. The control group receives a vague and open-ended commander’s guidance.

This dependent variable aims to identify *how* the officer solves the problem—for instance, analytically, graphically, pictorially, written, or a combination. Finally, the officers complete the second half of the LNMTSA. This dependent variable aims to identify whether the officer self-identifies a different linear/nonlinear balance, or change in any nonlinear thinking component, based on the treatment. The experiment is discussed using pre-vignette and post-vignette terminology. Pre-vignette refers to the results from the initial LNMTSA self-assessment and identifies the baseline thinking style for each officer. Post-vignette refers to the results after the treatments are provided and refers to the second half of the LNMTSA.

The following vignette is provided to each participant.

*You are one of four company commanders in a battalion-size unit that is preparing for an upcoming deployment. Given the proposed area of operations and other competing missions, your commander expects that he will not receive unmanned aircraft system (UAS) support that would typically be provided. He is reluctant to conduct the mission without UAS support due to the increased risk to force and decreased situational awareness in his operations center. Your commander has decided that an integral UAS capability within the battalion is the only way to ensure some level of UAS coverage for the upcoming mission. He also believes that a lack of external UAS support will continue in the coming years. Your commander has tasked you with standing up this new capability within your company. In order to force generate the required UAS personnel to man this new capability, he has authorized you to draw 15 non-commissioned officers (NCOs) from the other three companies to be employed outside their military occupational specialties (MOSs).*

***Your immediate task is to develop a course of action to select the most suitable individuals.*** *Your commander stresses that given the autonomy and technical complexity of this capability, the prospective operators must have well-above-average cognitive abilities.*

*Your commanding officer called you into his office and provided the following guidance [each participant randomly receives one of the following three treatments]:*



**1. Control Group Commander's Guidance**

*You are familiar with my expectations and decision-making process. Proceed with the task of selecting 15 NCOs for this new capability.*

**2. Linear Group Commander's Guidance**

*You are familiar with my expectations and decision-making process. Proceed with the task of selecting 15 NCOs for this new capability. You know I like to see logic laid out in a step-by-step methodical process that follows our established doctrinal guidelines and unit SOPs. As always, I want to see your mission analysis as it will increase the confidence of my decision. Brief me weekly on your progress and keep me abreast of any issues you encounter.*

**3. Balanced Group Commander's Guidance**

*You are familiar with my expectations and decision-making process. Proceed with the task of selecting 15 NCOs for this new capability. Use existing unit doctrine and standard operating procedures as a departure point, but do not hesitate to include creative options for completing the task. I encourage you to collaborate with your peers to develop an innovative course of action. Brief me when the task is complete.*

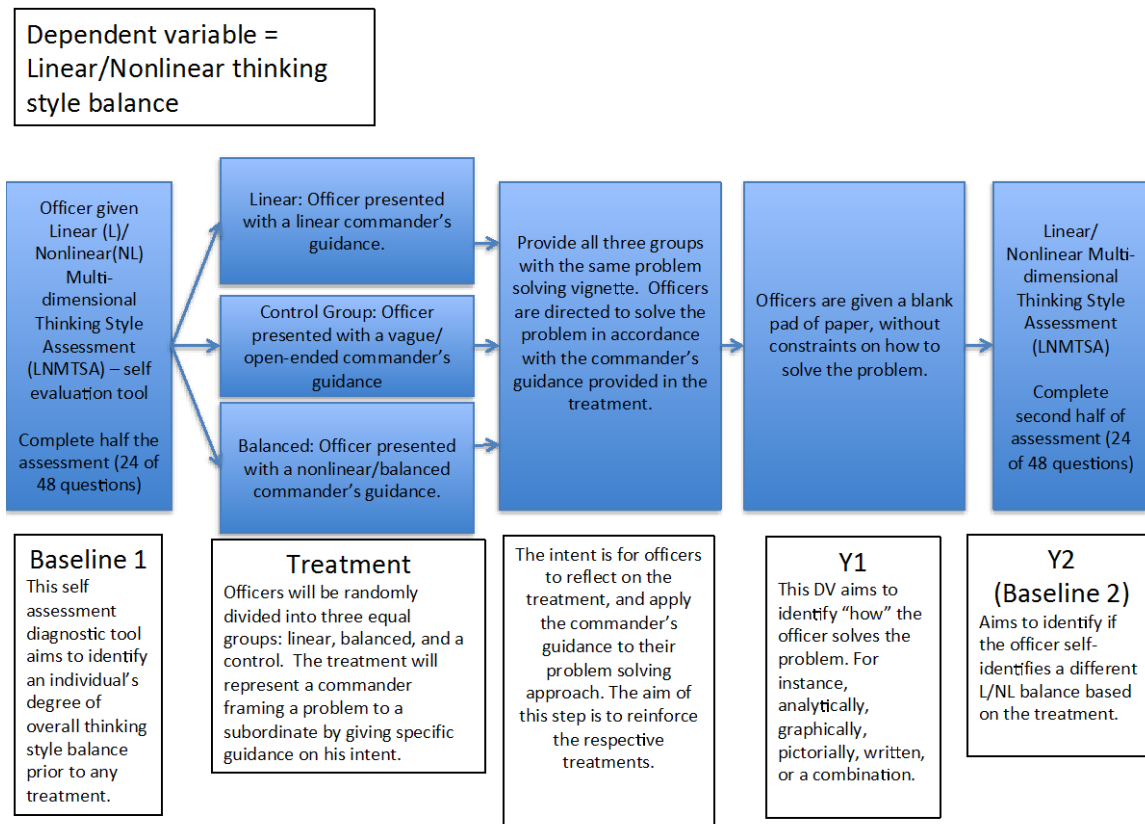


Figure 2. Research Methodology

#### D. EXPLANATION OF HYPOTHESES

Before presenting the results, I briefly revisit the hypotheses and show how they link to the empirical study.

##### 1. Explanation of Hypothesis One

The first step of the experiment is independent of the vignette, and therefore captures the subject's baseline thinking style. It is hypothesized that this baseline score is dependent on the culmination of his formal education, PME, work experience, military culture, and any other factors that have influenced his decision-making approach.

- Hypothesis One: Military decision makers have a baseline thinking style that favors linear thinking over nonlinear thinking.

Military officers at the O-3 and O-4 levels have been exposed to linear thinking and analytical problem solving throughout their PME careers. It is unlikely that they have received any formal or informal training in nonlinear thinking. Furthermore, doctrinal processes, standard operation procedures (SOPs), and military culture typically favor linear thinking. While there are no civilian subjects with which to compare the baseline scores of the military officers, the LNMTSA (Vance, 2013) provides a score that indicates the degree to which participants default to linear thinking over nonlinear thinking.

For the first step of the study, the only independent variable to the baseline thinking style score is the nationality of the participants. Seventy-six percent of participants were from the United States. Since the remaining 24% of the participants were from numerous countries (mostly western European), they are described as “non-U.S.” throughout the data analysis. The aim of the first step is to examine whether military decision makers favor linear over nonlinear thinking, and whether there is a difference in the baseline linear/nonlinear thinking style balance between U.S. and non-U.S. participants.

## **2. Explanation of Hypothesis Two**

The second step of the experiment involves a common vignette for all participants, followed by one of three treatments: control, linear, and nonlinear. Subjects were randomly selected for each of the three treatments, with 32 participants receiving the control, 33 receiving the linear treatment, and 33 receiving the nonlinear treatment. The total sample size was 98 participants.

- Hypothesis Two: The way a problem is framed affects the thinking style balance employed by the military decision maker.

The aim of step of this step is to determine the degree to which problem framing affects an individual’s decision making and thinking style balance. A key aspect of military decision making comes in the form of a *commander’s guidance*. This is typically the opportunity for a military commander to articulate his intent, set constraints and restraints, and clearly communicate his desired end state. Ideally, and in accordance with

the principle of *mission command*, the commander will avoid telling his subordinate *how* to solve the problem. With a clear indication of *what* needs to be accomplished, it should be left to the decision maker to decide *how* the problem is solved—in accordance with the aforementioned commander’s guidance.

This step of the experiment is designed to examine whether the content of a commander’s guidance can alter the baseline thinking style scores from Step One. Specifically, does a linear commander’s guidance cause the officer to apply a more linear problem-solving approach than identified in the baseline (pre-vignette)? Likewise, does a nonlinear commander’s guidance result in a shift towards a more nonlinear approach when compared to baseline scores? In addition to whether subjects have an overall shift towards more linear or nonlinear thinking styles, it is also possible to examine the seven components of nonlinear thinking separately to determine if any of them are particularly sensitive to commander’s guidance. To fully operationalize this hypothesis, each of the three subject groups are given five minutes to reflect on their respective commander’s guidance and identify how they would proceed with solving the problem identified in the vignette. All participants are then presented with another 24 questions from the LNMTSA (Vance, 2013), which provides post-vignette scores to compare to the baselines.

### **3. Explanation of Hypothesis Three**

The time taken to complete the experiment is another dependent variable that provides valuable insight into the role of problem framing in military decision-making.

- Hypothesis Three: When a decision maker is given linear guidance, they take longer to solve a problem than if given nonlinear guidance.

The elapsed time to complete the experiment is recorded for each of the 98 participants. The aim of this step is to determine whether a commander’s guidance can impact the time taken for an officer to solve a problem. While the time taken does not necessarily relate to the quality of the decision, it is nevertheless a critical aspect of military problem solving.

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## **IV. DATA AND DATA ANALYSIS**

### **A. GENERAL**

The first step of the experiment involves all participants completing 24 questions from the LNMTSA (Vance, 2013). Answers to these questions were used to create three variables (Vance, 2013): the linear score, the nonlinear score, and the thinking style balance (between linear and nonlinear). Adding up the responses for the three linear questions and dividing by three calculates the linear score. Adding up the responses for the 21 nonlinear questions and dividing by 21 calculates the nonlinear score. The nonlinear score is further subdivided into seven scores that reflect the seven components of nonlinear thinking. Adding up the three responses for each respective component and dividing by three calculates the score for each component of nonlinear thinking. The maximum score for linear thinking, nonlinear thinking, or any of the nonlinear thinking components is five. The lowest possible score is one. The overall thinking style balance (between linear and nonlinear) is calculated by subtracting the overall nonlinear score from the overall linear score. The more positive the thinking style balance score, the more linear dominant the participant. Conversely, the more negative the thinking style balance score, the more nonlinear dominant the participant. The highest possible thinking style balance score is 4.0, while the lowest possible score is -4.0. A strongly balanced linear/nonlinear profile score is between 0.5 and -0.5 (Vance, 2013). A profile is considered highly versatile if the thinking style balance is between 0.5 and -0.5, and the overall linear and nonlinear scores are each greater than 4.0. A profile is moderately versatile if the thinking style balance is between 0.5 and -0.5, and the overall linear and nonlinear scores are between 3.0 and 4.0 (Vance, 2013).

### **B. PRE-VIGNETTE DATA**

The baseline data following Step One of the experiment are presented in Table 1. As expected, the average linear score is greater than the average nonlinear score, with an average thinking style balance of 0.149. Applying the aforementioned criteria for highly and moderately versatile profiles, the baseline indicates 5 and 42 participants,

respectively. The data suggests that Hypothesis One is correct: Military decision makers have a baseline thinking style that favors linear thinking over nonlinear thinking. The data also suggests that few (only 5.1%) of military decision makers, who are all enrolled in a military postgraduate education program, are considered *highly versatile* thinkers. This is further discussed in the next chapter.

Table 1. Average Baseline Thinking Style Scores

VARIABLES	BASELINE (pre-vignette)
Average Linear Score	3.840
Average Nonlinear Score	3.691
Average Thinking Style Balance	0.149
Average Intuitive Thinking	3.167
Average Insightful Thinking	3.429
Average Creative Thinking	3.585
Average Flexible Thinking	4.010
Average Imaginative Thinking	3.939
Average Emotional Thinking	3.997
Average Value-Centered Thinking	3.714
Number of Highly Versatile profiles	5 (5.1%)
Number of Moderately Versatile	42 (42.9%)
Observations	98

The only independent variable to the baseline thinking style score in Step One of the experiment is the nationality of the participants. Participants were asked to identify their nationality prior to completing the first section of the survey. Seventy-six percent of

participants are from the United States, while the other 24% are from nations other than the United States.

It is interesting to find that the average baseline score for U.S. participants is 0.248 higher than for their non-U.S. counterparts, as displayed in Table 2. This finding is statistically significant, and raises many interesting questions for future research. In particular, is the finding a result of training and education systems within the respective militaries of the participants, or is the difference in linear bias a result of factors prior to military service? The significance of this finding is discussed further in Chapter V.

Table 2. Linear Score for U.S. Versus Non-U.S. Participants

VARIABLES	BASELINE LINEAR SCORE
United States	0.248*
	(0.140)
Constant	3.653***
	(0.122)
Observations	98
R-squared	0.0315
Standard errors in parentheses	
*** $p < .01$ , ** $p < .05$ , * $p < .1$	

### C. POST-VIGNETTE DATA

The second hypothesis relates to Steps Two and Three of the experiment. Step Two involves a common vignette for all participants, followed by one of three randomly assigned treatments: control, linear, and nonlinear. After communicating how they would solve the problem in accordance with their respective treatments, participants were given Step Three of the experiment, the final 24 questions of the LNMTSA (Vance, 2013). The



second set of 24 questions provides post-vignette scores for linear thinking, nonlinear thinking, and thinking style balance. In addition, these questions also provide a score for each of the seven components of nonlinear thinking.

Table 3 displays the average change for linear thinking, nonlinear thinking, and the seven nonlinear thinking components for each of the three treatment groups. Unexpectedly, Hypothesis Two was found to be false. There was not a statistically significant change in overall thinking style between the three treatment groups.

Table 3. Average Changes in Linear and Nonlinear Thinking Post-Vignette

VARIABLES	Control	Linear	Nonlinear
*Average Change			
Linear Score	-0.135	-0.192	-0.182
Nonlinear Score	0.007	-0.077	-0.007
Thinking Style	-0.116	-0.095	-0.175
Intuitive Thinking	-0.094	-0.051	-0.141
Insightful	0.219	0.152	0.162
Creative Thinking	0.104	-0.086	0.081
Flexible Thinking	-0.115	-0.121	-0.121
Imaginative	0.135	-0.030	0.000
Emotional	-0.042	-0.212	0.061
Value-Centered	-0.156	-0.182	-0.091

There is, however, a finding that provides partial support for Hypothesis Two. As displayed in Table 4, the linear treatment group displayed a statistically significant decrease in emotional thinking, which is a component of nonlinear thinking. On average, the participants who received the linear treatment have post-vignette emotional thinking

scores that are 0.254 lower than the control or nonlinear treatment groups. This is an extremely interesting finding that is further discussed in Chapter V.

Table 4. Linear Treatment and Emotional Thinking

VARIABLES	Post-Vignette Emotional Thinking
Baseline Emotional Thinking	0.155*
	(0.0897)
Linear	-0.254**
	(0.0991)
Control	0.160
	(0.0989)
Constant	3.439***
	(0.380)
Observations	98
R-squared	0.135
Standard errors in parentheses	
*** $p < .01$ , ** $p < .05$ , * $p < .1$	
Additional class controls not shown	

The final dependent variable examined is the time taken to complete the experiment. As expected in Hypothesis Three, the linear group took a statistically significant greater length of time to complete the experiment. Displayed in Table 5, the linear group took, on average, 171 seconds longer than the nonlinear or control groups. This finding is of particular interest as it contradicts a key rationale for linear thinking in the military—which is increased decision-making speed. This finding is further discussed in Chapter V.

Table 5. Linear Group and Time Taken to Complete Experiment

VARIABLES	Time taken to complete experiment
Nonlinear	-22.89
	(63.12)
Linear	171.4***
	(57.67)
Constant	946.2***
	(91.15)
Observations	98
R-squared	0.267
Standard errors in parentheses	
*** $p < .01$ , ** $p < .05$ , * $p < .1$	
Additional class controls not shown	

## **V. DISCUSSION**

### **A. FINDINGS**

Chapter IV outlined the statistically significant data from the experiment and introduces the findings in relation to the three thesis hypotheses. The following six key findings from the data analysis are discussed in this chapter:

1. Military decision makers have a baseline thinking style that favors linear thinking over nonlinear thinking.
2. A majority of the participants (52%) are below the threshold for being even “moderately versatile thinkers.”
3. The baseline thinking style for U.S. officers is significantly more linear than for non-U.S. officers.
4. On the one hand, the impact of framing was minimal. In particular, there was not a statistically significant change (pre- versus post-vignette) in overall thinking style between the three treatment groups (as a result of how the problem was framed).
5. On the other hand, framing had two critical results. First, the linear treatment resulted in significantly lower emotional thinking scores (post-vignette) compared to the control or nonlinear treatment groups.
6. Finally, the linear treatment group took significantly longer to complete the experiment than the control or nonlinear treatment groups.

Overall, the findings can be grouped into two broad categories. The first category includes the findings that are independent of the experiment vignette (reflecting the survey component of the study). These incorporate the first three findings listed above and represent baseline thinking characteristics of the participants. While the first finding—military decision makers favor linear over nonlinear thinking—was expected, the second and third unexpected findings provide unique insight into the baseline thinking styles of mid-level officers. This chapter discusses these findings with an aim to explain the results with the theory from Chapter II.

The second broad category includes Findings Four, Five, and Six. These three findings result from the experimental study and offer insight into the effects of problem framing on military decision makers. The fact that problem framing did not prove to have a statistically significant impact on post-vignette thinking style balance is an unexpected,

yet valuable finding. This chapter discusses potential causes for this finding, focusing on the heuristics and biases of military decision makers. The observed decrease in the linear group emotional thinking is also unexpected and is discussed based on current literature in the field of emotional intelligence. Finally, the result that the linear group took significantly longer to complete the experiment is discussed, challenging a longstanding belief in military culture that linear thinking is faster than nonlinear thinking.

Since this thesis is concerned with thinking style balance and fostering nonlinear thinking skills, the cross section of the participant pool is ideal. Assuming a lifelong career, officers at the O-4 level are approximately mid-way through their military service and have been significantly influenced by military culture and professional military education. Future employment will require increasingly advanced thinking skills, with an emphasis on strategic thought. Capturing data on participants at this rank level is valuable for two reasons. First, it provides a snapshot of thinking style at the mid-point of an officer's career. This is tremendously valuable in that it encompasses all of the components that form an individual's thinking style, including formal education, military culture, professional military education (PME), and life experiences, just to name a few. At a minimum, the data can be used to determine whether the current baseline thinking style for an O-4 is at a satisfactory level for optimum decision making at higher rank levels. Second, the data provides an indication of what, if anything, can be influenced by problem framing at the mid-point of an officer's career. Nevertheless, it is important to recognize that additional studies need to demonstrate the generalizability of these results to other officers, both inside and outside of the SOF, as well as to other decision makers more generally.

## **B. BASELINE THINKING STYLE DISCUSSION**

As presented in Chapter IV, the average baseline linear score is greater than the average baseline nonlinear score, with an average thinking style balance of 0.149. While this finding was very much expected, it is impossible to determine what causes this tendency towards linear thinking in the military. It is important to note that the contributing factors to an officer's thinking style cannot be viewed in isolation. Similar to

Figure 1 in Chapter II, the way an individual solves problems and makes decisions is a complex adaptive system. Nevertheless, some of the key components of such a system are presented in this section, offering multiple topics for future research and additional experimentation.

Starting from the beginning of an officer's career, military recruitment and selection could be one contributing factor to a particular type of thinking style. It is quite possible that the young men and women who are attracted to military service have a tendency towards linear thinking. Moreover, it is possible that applicants who are selected for service are in part successful based on their analytical thinking abilities. If this is in fact the case, and if the military desires more balanced thinkers, then a logical first step is to focus on recruiting individuals with these attributes. A moderately versatile thinker would still perform well in analytical linear tasks, but they would also perform well in environments that require innovation and creativity. A shift towards recruiting officers with a more balanced thinking style would increase the pool of officers at each rank that have these attributes, decreasing the training burden on the military organization.

Formal undergraduate university education is another aspect of an officer's career that can influence their thinking style. While it is impossible for the military to control the university education of all officers, it is possible to influence the curriculum of the military academies. Even in technical degrees such as science or engineering, it would be prudent to include courses in design thinking and other nonlinear topics in an effort to promote balanced thinking at the start of an officer's career. Unfortunately, it is a huge undertaking to study the feasibility and effectiveness of such an initiative, but the fact remains that nonlinear thinking should be introduced as early as possible.

Despite the attributes of a new military recruit, or the curriculum of an officer's undergraduate education, the most significant components that can influence an officer's thinking is military culture and PME. These are also the two components that can be influenced by the military organization and modified accordingly to create more balanced thinkers. This was introduced in Figure 1 in Chapter II as a complex adaptive system.

Officers are systematically rewarded for linear thinking, given PME opportunities that foster more linear thought, then rewarded for their performance through promotion to the next rank. What the data shows is that linear thinking is dominant over nonlinear thinking before officers are even given a problem to solve. It is highly likely that the analytical problem solving taught in basic military training sets the tone for military thinking throughout one's career. The MDMP is a highly prescriptive analytical tool for problem solving that offers extremely little latitude for so called "out of the box" thinking. Early PME is focused on MDMP, and it serves as the foundation for problem solving in military culture. This mindset is consistent even for PME at the O-4 level, where officers are instructed on the "operational" level of warfare at Command and Staff College. The curriculum for Command and Staff College, which is supposedly geared towards preparing an officer for employment at the O-5 level, is still highly linear in nature. Some services mention the term "design" (e.g., USMC), but this is not consistent with any current rendition of true design thinking. Even when learning doctrine for operational-level planning at the brigade level and above, the processes are still overwhelmingly linear and analytical. The bottom line is that by the time officers are at the O-4 level, they have been highly influenced by PME with a very linear focus. This linear focus is ingrained in military culture and thus officers are reluctant to change.

The positive aspect of this situation is that *some* officers are gaining exposure to balanced thinking. The predominant platform is through formal postgraduate education, with NPS serving as a perfect example. The Defense Analysis department in particular has embraced design thinking, offers a course in "dealing with wicked problems," and encourages groups of students to work on multisemester projects utilizing strategic design as the primary tool. Unfortunately, however, the officers exposed to this unique learning opportunity represent a very small minority. Furthermore, the data suggests that even officers enrolled in postgraduate education may still have a strong linear thinking bias.

The baseline data indicates that 5.1% of the 98 participants are highly versatile thinkers, while 42.9% are classified as moderately versatile thinkers (Finding Two).

Under these criteria, a slight majority of the participants (52%) are below the moderately versatile thinker threshold. This finding is somewhat surprising considering that all 98 participants are military officers enrolled in postgraduate education at the Naval Postgraduate School. While thinking style does not directly reflect on an officer's overall level of intelligence, the literature does support that a lack of balance can impede strategic thought. A hypothesis for the lack of highly versatile thinkers is that O-3 and O-4 officers are already well entrenched in their thinking styles. Despite potential exposure to balanced thinking styles at NPS, it is quite likely that a military decision maker's default problem-solving approach is resistant to change. This can be partly explained with heuristics and biases, and is further addressed when discussing Finding Four.

Another surprising finding is that the baseline thinking style for U.S. officers is significantly more linear than for non-U.S. officers (Finding Three). Once again, it is extremely difficult to determine what causes this result. This experiment did not test for potentially highly influential independent variables such as national education systems. For the purpose of this discussion, only factors within the sphere of military control are examined. Within the military organization, the two primary contributing factors to forming an officer's problem-solving approach are formal institutional training (in the form of PME) and doctrinal processes/standard operating procedures. It is hypothesized that in these regards, the U.S. military may have a more linear focus when compared to international partners. It would be highly valuable to conduct further research that examines the differences and similarities of PME and military problem-solving doctrine between nations.

Looking back at Figure 1 in Chapter II, the current incentive structure for both the U.S. and Canadian militaries is merit-based, with PME requirements at each rank level. The PME curriculums focus on linear and analytical processes, which directly relate to the planning and problem-solving doctrines employed in daily operations. It is difficult to pinpoint exactly the origin of the preference for linear thinking. Since linear thinking is so ingrained in military culture and operations, it is the focus of PME and advanced military training. When officers receive this PME and training, they are further



incentivized to employ more linear thinking. A possible intervention point to break this vicious cycle is presented in Chapter VI.

### **C. POST-VIGNETTE THINKING STYLE DISCUSSION**

While the previous discussion looks at the survey results supporting Hypothesis One, what are the implications of the experimental findings regarding Hypotheses Two and Three? The data shows that there is not a statistically significant change (post-vignette) in overall thinking style between the three treatment groups resulting from how the problem was framed, as claimed by Hypothesis Two. While this result is unexpected, it might be tied to the initial finding that military decision makers have a linear bias. Studies suggest that “people rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgment operations” (Gartner, 1997; Kahneman & Tversky, 1974, p. 1).

In a similar fashion, military organizations make strategic decisions based on sets of *dominant indicators* (Gartner, 1997, p. 44). These indicators represent the most important quantitative data to the organization and form the lens through which a given problem is perceived. Making decisions based on dominant indicators is in large part a linear process. The decision maker starts with a departure point based on pre-determined organizational preferences, thereby shifting focus towards these indicators in a predictable and systematic fashion. This pre-disposed train of thought has the potential to impede nonlinear thinking and offers support to the findings of Hypothesis Two.

In particular, two heuristics are at play when the decision maker is faced with the experimental vignette: representativeness and availability (Kahneman & Tversky, 1974). Representativeness is when people assign probabilities that two events or processes are related based on the degree to which they resemble one another. For instance, when Event A is highly representative of Process B, the probability of A originating from B is judged to be high (Kahneman & Tversky, 1974, p. 2). In the context of this thesis, the representativeness heuristic takes hold immediately upon the officer reading the problem-solving vignette. In this case, the event is the problem, and the process is the thinking style employed by the officer. The illusion of validity is the specific aspect of the

representative heuristic that may help to explain Finding Four. This illusion is based on an unwarranted confidence that linear thinking is a good fit for solving the problem (Kahneman & Tversky, 1974, p. 5). This unwarranted confidence is formed from a pattern of consistency—using linear thinking to solve military problems—that has developed over an officer’s career. As a result, the officer employs the thinking style that he deems appropriate, based on the patterns he has used and been exposed to while in the military. As already discussed, this finding highlights a vicious cycle that promulgates linear thinking regardless of the problem space. The officer is choosing his thinking style based on a learned pattern, as opposed to what would be optimal to solve the problem. Regardless of the commander’s guidance (the treatment), the representativeness heuristic has already set the officer down a linear thinking path.

The second relevant heuristic to this thesis is *availability*. This refers to the tendency of people to assess frequency or probability of a particular event by the ease with which the decision maker can recall similar events (Kahneman & Tversky, 1974). Specifically, officers are succumbing to cognitive biases due to the retrievability of instances. In this case, participants are simply thinking back to similar problems they have been asked to solve. Given the results of Finding One—that military officers favor linear thinking—it is likely that similar past problems were solved using linear thinking techniques. Similar to the representativeness heuristic, a commander’s guidance is not sufficient to overcome the default thinking style employed by the officer.

The most recent literature provides an explanation for the role of intuition in decision-making heuristics and biases (Kahneman, 2011, p. 4). Specifically, there is a focus on the flaws of intuitive thought in decision making (Kahneman, 2011, p. 10). Of particular importance to this thesis is the fact that “prolonged practice” and “skill” are critical ingredients of intuition, offering a more holistic view of what forms intuitive judgment. This latest research supports the idea that a military decision maker may indeed come to an optimum decision based on his intuition, which is formed by his skill and prolonged practice. The question remains, however, how does one know when intuition is being negatively affected by heuristics and biases? Furthermore, at what level

does a military decision maker become expert enough to rely on his intuition when making decisions? Even more important to consider, how does intuitive thought hinder nonlinear thinking that could possibly lead to a more optimum decision? The data from this thesis supports the fact that individual thinking style is not easily influenced. There is a complex balance between intuition (skill and practice), heuristics, and biases that determine how a military decision maker solves a problem. It is hypothesized that a commander's guidance (linear or nonlinear) is simply not sufficient to influence an officer's thinking style balance.

The fifth finding is that the linear treatment resulted in significantly lower emotional thinking scores (post-vignette) compared to the control or nonlinear treatment groups. Since emotional thinking is one of the seven components of nonlinear thinking, this finding does support the second hypothesis. The commander's guidance (the treatment) did have an impact on emotional thinking scores. It is particularly interesting that rather than an increase in emotional thinking for the nonlinear treatment, there was a decrease in emotional thinking for the linear treatment. On average, the participants who received the linear treatment have post-vignette emotional thinking scores that are 0.254 points lower than the control or nonlinear treatment groups.

This finding suggests that an individual's propensity to apply emotional thinking is actually decreased when a problem is presented with linear commander's guidance. Therefore, as expected, linear problem framing has the potential to stifle components of nonlinear thinking, and increases uniformity of thought in a given organization. If a particular commander always provides highly linear guidance in line with historical and cultural norms, the data suggests that emotional thinking will be suppressed. This finding may be somewhat explained by the losses/gains frames discussed in Chapter II. Specifically, Kahneman and Tversky (1983) explained the framing of outcomes. They revealed that when a problem is viewed in a losses frame, decision makers are more risk seeking, while in a gains frame they are more risk averse (Kahneman & Tversky, 1983). When a military subordinate is given a problem by his superior, the default frame is one of gains. The subordinate is simply expected to apply the doctrinal—and culturally

accepted—organizational problem-solving tools to complete the task. Completing the task in accordance with the commander's intent will be rewarded, and there is little incentive for taking undue risks. Even if the subordinate is inclined to apply nonlinear thinking—specifically emotional thinking in this case—a linear commander's guidance may be enough to bring the subordinate's thinking style back to a linear bias. Therefore, the gains frame of the subordinate makes him more risk averse, resulting in less incentive to apply nonlinear thought.

The sixth and final finding is that the linear treatment group took significantly longer to complete the experiment than the control or nonlinear treatment groups. While this may perhaps contradict a belief in military culture that linear thinking results in faster decision-making, it is in fact an expected finding. The reason for this expectation is that problem solvers become more concerned with the process, rather than the quality of the solution. Similar to the explanation for Finding Five, when a subordinate receives a problem from his superior, there is a generally accepted doctrinal process to solve it. A linear commander's guidance may go as far as demanding to see the linear process that was followed, essentially verifying that the decision-making status quo was adhered to by the subordinate.

The result of the linear thinking expectation focuses the attention of the subordinate on the process, rather than finding an optimal solution. Depending on the subordinate's familiarity with the preferred organizational linear process, it may take considerable time to think through the required steps, let alone solve the actual problem. The data shows that the time taken for the linear treatment group was significantly longer, suggesting a very strong correlation. Simply put, in addition to the aforementioned benefits of nonlinear thinking for decision quality, nonlinear/balanced guidance can also lead to faster decisions.

The combination of these six findings provides extremely valuable insight to military commanders. First, as expected, subordinates will enter problem-solving tasks with a linear thinking bias, and the majority will fall below the threshold for being considered moderately versatile thinkers. Until professional military education and

organizational culture evolve to embrace nonlinear thinking, the onus is on the commander to influence subordinates towards a balanced thinking style. While the commander's guidance may not be sufficient to alter the overall thinking style balance of his subordinates, it does have the power to impact certain components of the decision-making process. Specifically, linear guidance is shown to reduce emotional thinking, which is a key component of nonlinear thought. Furthermore, linear guidance is also shown to increase a subordinate's time taken to solve a problem. This suggests that linear guidance may be sub-optimal for certain types of military problems, and the commander can indeed influence the thinking style used by his subordinates to a certain degree.

The deficiency in military nonlinear and strategic thought can be described as a vicious cycle. There are numerous potential intervention points to target in an effort to improve military thinking, and this thesis serves to highlight one particular aspect. The way a superior frames a problem to a subordinate has an impact on the cognitive approach used to solve a problem. If a commander seeks an innovative and creative solution to a particular problem, it is important that his guidance is not linear in nature, for this has the ability to stifle balanced thinking. Furthermore, military organizations will only grow to accept a balanced thinking style if there is widespread exposure to and acceptance of this new way of military thinking. Commanders hold positions of influence to spark such change, and a critical first step is to foster balanced thinking at every level.

## VI. RECOMMENDATIONS

Future research should focus on gathering data for a similar sample of civilian participants and officers outside of a postgraduate school setting. In particular, it would be valuable to determine if the majority of civilian postgraduate students would also fall below the threshold for being “moderately versatile thinkers.” It would also be interesting to compare baseline thinking styles (pre-vignette) between military and civilian counterparts. A broader sample of military personnel would also add insight to the findings. Expanding the experiment to both lower and higher ranks, as well as conducting it in active duty units, would provide a richer overall sample. The higher baseline linear thinking scores for U.S. officers compared to their non-U.S. counterparts also deserve further study. Perhaps the U.S. military can look to international partners for professional military education practices that develop nonlinear thinking skills?

The model for Canadian officer progression/assessment is used to explain a possible intervention point for disrupting the vicious cycle discussed in Chapter V. As displayed in Figure 1, the military focus on linear thinking, and the inherent rewards, ultimately trump the incentives for strategic thinking. The vicious cycle depicted by R2 in Figure 1 highlights the core problem, which is the officer incentive structure. It is important to note that the incentive structure is not unique to officers; rather, the same structure exists for all rank levels in the Canadian Armed Forces. This thesis, however, focuses on officers at the O-3/O-4 level who will soon be responsible for thinking strategically at higher appointments and ranks.

A recommended way to stop the R2 cycle is to target the career-long positive reinforcement that rewards linear thinking skills. The current incentive structure rewards O-3 and O-4 officers who can best apply the military decision-making process (MDMP) and operational planning process (OPP), respectively. Both the MDMP and OPP are highly linear analytical problem-solving tools. They form the bedrock of military planning, and officers who expertly apply these tools are rewarded with strong annual assessments. Strong annual assessments lead to additional PME opportunities, which

eventually result in an officer being ranked high enough among his peers for promotion. A balance between linear and nonlinear thinking is required to stop both the R1 and R2 vicious cycles.

The current Canadian Forces Personnel Appraisal System (CFPAS) does not include any assessment criteria that reward nonlinear thinking or creativity. The initial recommendation is therefore quite simple. The CFPAS process should be updated to include criteria that are directly related to nonlinear thinking. While this intervention appears quite subtle on the surface, it is reasonable to believe that changing the incentive structure will change behavior. It is not a matter of officers under the current system consciously evading nonlinear thinking; rather, it is a matter of opportunity cost. Under the current CFPAS incentive structure, officers are simply not rewarded for demonstrating criteria that are not on the assessment form. Therefore, time is better spent on the status quo linear thinking criteria that are inherent in the incentive structure. Simply put: change the incentive structure, change the behavior.

While a modified incentive structure is easy to hypothesize, facilitating such a change in a military institution is not without hurdles. First and foremost, the intervention must be data-driven, demonstrating a causal link between the incentive structure and desired performance. An additional experiment is recommended to study the impact of adding nonlinear and creative incentives to military problem solving. If experimental data can show a causal link, then the intervention will have a far greater chance of gaining support and momentum.

The next aspect of the model of change involves a network of like-minded people who will support the intervention. The selection of these personnel must be methodical and calculating, ensuring that a strong base of support exists to champion the intervention. The starting point should be training and development officers (TDOs) and personnel selection officers (PSOs). These officers are responsible for developing training programs throughout the Canadian Armed Forces, as well as identifying the attributes and skills required for military personnel. They would be valuable resources for refining and administering the experiment, and achieving their “buy-in” at an early stage

would create strong momentum for pushing this initiative. Furthermore, the involvement of the TDO and PSO would add heightened accountability and validity to the data gained from the experiment, enhancing the credibility of the entire process.

The third aspect of the model of change is based on selecting an organization where there is a belief that change can occur. Ideal organizations are small units that embrace innovation and promulgate cultures that welcome new ideas. Such an atmosphere is ideal for implementing an augmented CFPAS process that will change the incentive structure to support nonlinear thinking and creativity.



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## APPENDIX A. IRB APPLICATION

Last updated: 1-25-13

**NPS IRB**  
**Initial Review Application**

Only complete packages will be reviewed by the HRPP Specialist. To ensure your package is complete, reference the IRB application guidance sheet at the end of this package. Submit complete packages to Rikki Nguyen at [rapenis@nps.edu](mailto:rapenis@nps.edu) or in HA-206.

Protocol# \_\_\_\_\_

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**Research Basics**

1. Title of the research. Fostering Thinking Style Balance: Implications for Professional Military Education and Problem Framing

2. Investigators. List additional researchers on a separate page.

- Principal Investigator

Name	Title	Dept.	Roles and Responsibilities in the Research
Dr. Leo Blanken	Assistant Professor	DA	Thesis advisor, principal investigator, recruitment, & data analysis

- Co-Investigator(s), Student Investigator(s) & Key Research Personnel

Name	Title	Dept.	Roles and Responsibilities in the Research
Dr. Scott Gartner	Visiting Professor	DA	Thesis advisor, investigator, recruitment, & data analysis
Maj Michael Laplante	Student	DA	Student Investigator, recruitment, & data analysis

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**Research Summary**

3. Requested start date: 15 Oct 2014 4. Estimated completion date: 31 Mar 2015 5. Will surveys be used? ☐ No ☒ Yes

6. Is this study in support of student research? ☐ No ☒ Yes, attach approved proposal. 6b. Is this research part of a funded project? ☒ No ☐ Yes, attach approved proposal and list JON:  

7. Are investigators unaffiliated with NPS engaged in the research? ☒ No ☐ Yes

8. Where will the research be performed? In person at NPS 8b. Will any research activities take place outside the US? ☒ No ☐ Yes, attach host country approval and ethics review.

9. Summarize the objective(s) of the research including purpose, research question, hypothesis & background information, literature, etc.

The aim of this thesis is to identify if the way a problem is framed affects an individual's psychological perception of thinking style balance. Current literature suggests that a balanced approach between linear and nonlinear thinking can provide a "powerful synergy" toward optimal strategic thinking and military decision making (Vance, 2013, p. 205). The problem, however, is that such a balance is not part of current PME doctrine. Furthermore, the military focus on linear thinking is promoted in daily operations, stifling the seven recognized components of nonlinear thinking (intuition, insight, creativity, flexibility, imagination, emotion, and value) and subsequently inhibiting strategic thought. The research question is: Does the way a problem is framed affect an individual's psychological perception of thinking style balance?

Hypothesis 1: SOF decision makers, by virtue of their institutional training, gravitate towards linear thinking regardless of the problem space. Hypothesis 2: The way a problem is framed affects the thinking style balance employed by the military decision maker.

10. Describe the research study design. If additional space is needed please attach a separate page to the back of the application or reference research proposal.

The research involves three steps: Step one is a 24 question survey to obtain a baseline for a subject's thinking style balance. Step two provides subjects with a problem solving vignette. After reading the vignette subjects receive one of three treatments and are asked to solve the problem. Step three is an additional 24 question survey that aims to identify if there is a change in thinking style balance as a result of the treatments.

Please refer to the following attachments for a detailed explanation of the research study design:

1. Linear/Nonlinear Multidimensional Thinking Style Assessment (LNMTSA) Instrument (Annex A).
2. Experiment methodology (Annex B).
3. Vignette (Annex C).
4. Treatments (Annex D).

11. Describe in detail the tasks subjects will be asked to perform and the amount of time it will take to complete each task. Include the full range of interactions, observations etc.

1. Researcher will brief the experiment and purpose of the research. Subjects will be asked to complete the consent form - 5 minutes.  
 2. Subjects will be split into three equal groups (control, linear and nonlinear). - 1 minute.  
 2. Subjects will be asked to complete 24 questions from the Linear/Nonlinear Multidimensional Thinking Style Assessment (LNMTSA) Instrument - 8 minutes.  
 3. Subjects from all three groups will read a common vignette and a Commander's guidance based on which group they are in - 4 minutes.  
 4. Subjects will be asked to provide a very brief overview of how they would choose to solve the problem, without any constraints or requirements. They will be given a pad of paper and writing instrument - they will be stopped after 5 minutes.  
 5. Subjects will be asked to complete 24 questions from the Linear/Nonlinear Multidimensional Thinking Style Assessment (LNMTSA) Instrument - 8 minutes.  
 Debrief - 2 minutes.  
 Total: 33 mins. All tasks will take place in succession. The location will be in a NPS classroom within the Defense Analysis department.

12. The following areas of research require approval outside NPS. Please check all that apply.

☐ Classified research      ☐ Severe or unusual intrusions, either physical or physiological on humans subjects  
☐ Potential or inherent controversial topics (those likely to attract media coverage or challenge by interest groups)

**Subject Population and Recruitment**

13. Special Populations. Check all that apply.

☒ Military Personnel    ☒ NPS Students    ☐ Non-English Speakers    ☐ Economically/Politically/Educationally Disadvantaged  
☐ DoD Personnel    ☐ NPS Employees    ☐ Foreign Nationals    ☐ Mentally/Emotionally/Developmentally Disabled Persons  
☐ Contractors    ☐ Children Under 18    ☐ Prisoners    ☐ Pregnant Women / Fetuses  
☐ Elderly Over 70

14. List the inclusion/exclusion criteria.

Any NPS student of the Captain (O-3) or Major (O-4) rank is eligible. There are no exclusions for age, gender, service, or any demographic criteria.

15. Is the target population adequate to provide the determined sample size. ☐ No ☒ Yes

16. Provide the sample size and the rationale for why that number is chosen.

Participation in the experiment will be presented to 150-300 officers at NPS. The final sample size will depend on the turnout rate, however, the aim is to enroll 100 participants in order to make the data statistically significant.

17. Does the research involve the use of existing records?

☒ No, skip to question 18.    ☐ Yes, describe the records, include the data points and the number of records.

17b. Are the records private? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes, attach proof of approval to access the data for your research.
17c. For what purpose will these records be used? <input checked="" type="checkbox"/> To collect data <input type="checkbox"/> Identify potential subjects <input type="checkbox"/> Other, describe below.  
18. Will compensation be given to research subject? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes, describe the purpose of compensation.  
19. Describe how potential subjects will be recruited to participate in the research.  Potential subjects will be recruited from the NPS student body: a. email will be the means of recruitment (Refer to Annex E) b. Subjects will be recruited following IRB approval c. Subjects will only be solicited for participation one time d. All recruitment will take place on the NPS campus and through NPS information systems e. The principal investigator, investigator, and student investigator will conduct the recruitment f. The Principal investigator and investigator will not recruit their own students g. Subject contact information will be obtained through curriculum officers h. No senior leadership will be present or participate during recruitment activities  A copy of the recruitment email is attached.
20. How will you minimize coercion and undue influence during the recruitment process?  Participation will be strictly voluntary. a. Only officers of Captain and Major rank will be recruited b. No ombudsman will be used c. No members of the senior leadership will suggest, request, or claim support of the research.
<b>Risk and Benefits</b>
21. Does the research involve any of these possible risks or harms to subjects? Check all that apply.  <input type="checkbox"/> Use of deception <input type="checkbox"/> Physiological risk <input type="checkbox"/> Use of private records <input type="checkbox"/> Social or economical risk <input type="checkbox"/> Employment risk <input type="checkbox"/> Physical risk <input type="checkbox"/> Legal risk <input type="checkbox"/> Presentation of materials that might be considered sensitive, offensive, threatening or degrading <input type="checkbox"/> Possible invasions of privacy of subjects or family <input type="checkbox"/> Probing for personal or sensitive information <input type="checkbox"/> Manipulation of physiological or social variables such as sensory deprivation, social isolation, psychological stresses
22. Describe any foreseeable risks or discomforts associated with the research.  Risks are very minimal, however, they cannot be eliminated completely. The following are foreseeable risks:  a. upsetting subjects with survey questions. b. creating doubt in a subject that they are employing an optimum thinking style balance in their military decision making. c. creating questions regarding problem framing in past, current, and future work environments. d. creating curiosity and competition amongst peers.

<p>23. Explain what steps will be taken to minimize risks and harms (mentioned in Q21-22) and to protect subjects' welfare.</p> <p>The following steps will be taken to minimize the foreseeable risks identified in question 22:</p> <p>a. Subjects will be thoroughly debriefed after completing the experiment. It will be made clear that there is no correct or incorrect response to the survey.</p> <p>b. Subjects will be debriefed that there is no identified link between their thinking style balance and future performance or potential.</p> <p>c. Scores will not be calculated immediately after the experiment or disseminated to the subjects.</p>
<p>24. Provide a description of the potential benefits of this research for individuals, subjects, society, military or DoD/DoN. Explain how risks are reasonable in relation to anticipated benefits.</p> <p>This research has direct and easy to implement benefits to the military. If hypothesis one is found to be true, PME can be adjusted to create a more balanced thinking style in military decision makers. If hypothesis two is found to be true, military leaders can frame problems in a manner that promotes a balanced thinking style.</p>
<p><b>Data Security &amp; Monitoring</b></p>
<p>25. Will you record identifiers such as name, social security number, address, telephone number or any combination of demographic data that could lead to the identification of a participant?</p> <p><input checked="" type="checkbox"/> No <input type="checkbox"/> Yes, Explain why it is necessary to collect these identifiers. If you will use a coding system to protect against disclosure of identifiers, describe below.</p>
<p>26. Will you audio or video record subjects?</p> <p><input checked="" type="checkbox"/> No <input type="checkbox"/> Yes, describe what will be recorded, why you are recording, if the recording will be transcribed and how you will safeguard the recording. Ensure this information is included in the consent form under "procedures".</p>
<p>27. How will data and consent forms be kept confidential during collection, analysis, and storage?</p> <p>All data will be saved on a password protected computer. No personal information will be associated with the data besides general demographic data. All hard copy consent forms and surveys will be locked in storage in the defense analysis department.</p>
<p>28. When appropriate, the research plan is required to make adequate provisions for monitoring the data to ensure safety of subjects. Will you monitor data collection? <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes, describe your plan to monitor the data.</p> <p>The experiment will be monitored by the student investigator to answer questions and provide clarification if required. There are minimal foreseeable risks to the subjects.</p>

<b>Consent.</b> Consent must be obtained and documented except when waived or altered in accordance with NPS Policy.	
29a. Are you obtaining consent from subjects? <input type="checkbox"/> No, attach a Waiver or Alteration of Informed Consent Form and skip to question 31. <input checked="" type="checkbox"/> Yes	
29c. Will subjects sign the consent form? <input type="checkbox"/> No, attach a Waiver of Documented Consent Form. <input checked="" type="checkbox"/> Yes	
29b. Will you provide subjects with a consent form? <input type="checkbox"/> No, attach a Waiver of Documented Consent Form. <input checked="" type="checkbox"/> Yes	
29d. Will the consent form will include all federally required elements of informed consent? <input type="checkbox"/> No, attach a Waiver or Alteration of Informed Consent Form and skip to question 31. <input checked="" type="checkbox"/> Yes	
30. Will you request to quote subjects? <input checked="" type="checkbox"/> No. <input type="checkbox"/> Yes, include a check box on the consent form asking for permission to quote.	
31. Describe the consent process and how the potential for coercion or undue influence will be minimized.	
<p>Please see attached consent form (Annex F). The student investigator is responsible for obtaining consent, and will provided the consent forms in the classroom in person at the beginning of the experiment. Subjects will keep a copy, and the signed consent forms will be stored in the Defense Analysis Department for the duration of the research.</p> <p>All participation is strictly voluntary and if subjects do not sign the consent form they will not carry on with the experiment.</p>	

#### Principal Investigator's Statement of Assurance

As the principal investigator I assume overall responsibility for the protection of human subjects. I assume responsibility for ensuring the integrity and ethical conduct of the co-investigator(s) and student researcher(s).

I certify that the co-investigator(s) and/or student researcher(s) is/are trained and fully competent to accomplish the goals and techniques stated in the attached proposal and have completed the required ethics training.

It is my responsibility to ensure that legally effective informed consent/assent will be obtained using the IRB approved consent document in accordance with federal, DOD/DON requirements prior to the start of research unless explicitly waived by the IRB.

I will not implement changes to approved research without IRB and institutional approval except when necessary to eliminate apparent immediate hazards to the subject and will submit an amendment to the IRB afterwards.

I will inform the IRB Chair or Vice Chair, and the Medical Monitor (if research is greater than minimal risk) of any unanticipated problems and serious adverse events within 24 hours. I will submit an unanticipated problem and serious adverse events report form to the IRB within 5 days.

I have no conflict of interest negating me from performing this research.

I will maintain all research records on file; and I recognize that the IRB has the authority to observe or have a third party observe the consent process and inspect all research records at any time.

I understand that human subjects research activities, including recruitment, may not commence until the IRB completes its review and recommends approval, and the President approves the research.

I understand that a continuing review of the research must be reviewed by the IRB and approved by the President before the expiration date or all research activities must stop and I will submit a final report to the IRB.

I have read, understand, and agree to follow the NPS Instruction on the Protection of Human Subjects.

PI Signature:  
*Now accepting digital signatures.*

Date:

## IRB Application Guidance Document

This document will help ensure you provide the information necessary for the IRB to review your research.

### Research Basics

1. **Title of the Research.** Please ensure the title listed is consistent across all IRB application documents.
2. **Investigators and Key Research Personnel.** The Principal Investigator (PI) is the principal researcher who is ultimately responsible for the conduct of the research. For student research the PI is the thesis advisor. Please list each person's role and responsibility in the research (i.e., obtain informed consent, recruit subjects, analyze data, design data collection tools, write paper, etc.).

### Research Summary

3. **Requested start date.** This is the date you would like to start the research. Please note you may not begin research activities (including subject recruitment) until the IRB and NPS President have approved your research.
4. **Estimated date of completion.** On student research projects the estimated date of completion cannot be greater than the student's graduation date.
5. **Will surveys be used?** Check the appropriate box. Surveys conducted across multiple commands may require additional approval outside the NPS IRB.
6. **Is this study in support of student research or funded project?** If yes to either question, attach the approved proposal. Please note, the IRB cannot approve research that is not first approved by your department.
7. **Are researchers unaffiliated with NPS engaged in the research?** Unaffiliated investigators are members of your research team that are not NPS faculty, staff, or student. All unaffiliated investigators (including contractors) require assurance to conduct research with human subjects. For additional information contact Ms. Rikki Panis, 831-656-2998, [rapanis@nps.edu](mailto:rapanis@nps.edu).
8. **Where will the research take place?** If conducted over the phone, through email, or online, indicate phone, online, or email. If in person, list the name of the command(s), university/school(s), training site(s), ship(s), etc.
- 8b. **Will any research activities take place outside the US?** Host country approval to conduct research and a host country ethics review is required for all research conducted outside the US. For additional information contact the IRB Vice Chair, Dr. Maiah Jaskoski at 831-656-3167 or [majaskos@nps.edu](mailto:majaskos@nps.edu).
9. **Summarize the research objectives.** Include the following:
  - a. purpose of the research
  - b. research questions
  - c. hypothesis
  - d. relevant background informationDo not state "see research proposal." Provide a summary and if additional space is needed you may reference the research proposal.
10. **Describe the research study design.** If additional space is needed please attach a separate page to the IRB application.
11. **Describe in detail what tasks subjects will be asked to perform.**
  - a. Describe tasks in chronological order (i.e. consent, equipment calibration, data collection, post research activities, etc.).
  - b. Provide enough detail so that someone not involved with the research would be able to read the description and understand exactly what you are asking subjects to do.
  - c. State when and where each task will be completed.
  - d. State how long each task is expected to take. This includes the time it takes to obtain consent, screening activities, calibration activities, data collection and post research activities.If your research only involves the analysis of pre-collected records, type N/A in the box.  
Attach all data collection tools (i.e. surveys, interview protocols, tests, etc.)  
  
Surveys and interviews conducted across multiple commands may require additional approval outside the NPS IRB. C
12. **The following areas of research require approval outside NPS.** Check all that apply. For additional information contact Ms. Rikki Panis, 831-656-2998, [rapanis@nps.edu](mailto:rapanis@nps.edu).

### Subject Population and Recruitment

13. **Special populations.** Check all that apply. The populations listed are considered vulnerable and may require additional protections. The IRB will determine what additional protections are necessary during the review process.
14. **List the inclusion and exclusion criteria.** Specify the characteristics that must be met for individuals to be included and excluded from your study. Include the following:
- Any experiences such as positions held, deployments, training, that will qualify or disqualify subjects.
  - Include age range, gender, service, and any other demographics that qualify or disqualify subjects.
  - Subject age range. Please note minors (under the age of 18) require the assent from the minor and consent from the parents.
15. **Is the target population adequate to provide the determined sample size?** Check yes or no.
16. **Provide the sample size and the rationale for why that number is chosen.** Provide an accurate number. Once you have enrolled the approved number of subjects enrollment must stop. To increase enrollment after approval, the PI must submit an amendment for IRB review and approval. If your research only involves the analysis of pre-collected records place a "0" in the box.
17. **Does the research involve collection or use of existing records?** If yes, include the following:
- Describe the records.
  - List the data points provided in the records.
  - State where the records are located.
  - State the number of records you will access.
- B. Are the records private?** If you require permission, a password, or you have to request access to the data, it is private. Include the name of the person or organization that granted access and attach a copy of their approval.
- C. For what purpose will these records be used?** Check the appropriate box.
18. **Will compensation be given to research subjects?** If yes, include the following:
- Explain why compensation is offered.
  - State what the compensation consists of and the estimated dollar value.
  - Describe how the level of compensation is determined.
- Compensation for active duty military during normal business hours must meet the requirements of DoDI 3216.02.
19. **Describe how potential subjects will be recruited.** Describe in detail the recruitment procedures (how you will ask potential subjects to participate in your research). Include the following:
- Describe how subjects are recruited (i.e., e-mail, phone, in-person, flyers, group presentations, etc.).
  - State when potential subjects will be recruited.
  - State the number of times each potential subject will be solicited to participate.
  - State the location recruitment will take place.
  - State who will conduct the recruitment.
  - Include how potential subject contact information will be obtained.
  - Senior leadership may not participate or be present during recruitment activities.

Attach all recruitment materials (i.e., e-mails, flyers, scripts, presentation slides, URLs, etc.). All recruitment materials must include the following:

- State the study is research.
- Identify NPS as the institution performing the research.
- Clearly state the purpose of the research.
- Describe procedures subjects are expected to perform.
- Describe realistic benefits. If no benefit, state there is no benefit to the individual for participating.
- Describe foreseeable risks.
- State participation is voluntary.
- Describe the sign-up process.
- Include contact information for the principal investigator and IRB chair.



20. **How will you minimize coercion and undue influence during the recruitment process?** Coercion occurs when an overt or implicit threat of harm is intentionally presented in order to obtain compliance. Undue influence occurs through an offer of an excessive or inappropriate reward or other overture in order to obtain compliance. Consider the following:
- Will officers and enlisted be recruited separately?
  - Will an ombudsman be used?
  - Are instructors recruiting their own students?
  - Are members of senior leadership suggesting, requesting, or claiming support of the research?

#### Risks and Benefits

21. **Does the research involve any of these possible risks or harms to subjects?** Check all that apply.
22. **Describe any foreseeable risks associated with the research.** Common risks associated with research at NPS include: breach of confidentiality, employment risk, stress reactions, and motion sickness. Describe each risk in detail including risks noted in Q21.
23. **Explain what steps will be taken to minimize risks or harms and protect subjects' welfare.** Include a plan to minimize all risks mentioned in Q21 and Q22.
24. **Provide a description of potential benefits of this research for individuals, subjects, society, military or DOD/DON.** Explain how risks are reasonable in relation to anticipated benefits. The IRB will not approve research that does not provide potential benefits.

#### Data Security

25. **Will you record any identifiers such as names, SSN, address, phone numbers or any combination of demographic data that could lead to identification of a participant?** Identifiers are more than just name and SSN. With enough demographic data, identification is possible (i.e., gender, ethnicity, marital status, rank, service, MOS, billets, assignment dates, etc.).
26. **Will audio or video recording take place during subject participation?** Describe in detail what will be recorded, why you need to record and how the data will be stored and safeguarded. Please note that recordings cannot be deleted unless transcribed.
27. **How will the data (including consent forms) be kept confidential during collection, analysis and storage? Please include the following information:**
- State who will have access to the data.
  - State where the data will be kept (hard copy and electronic copy). Please note that personally identifiable information may not be stored on external hard drives (including flash/thumb drives) and may not be transferred on a laptop computer.
  - State who will maintain the data after the research is complete. DON requires all data, research notes, and consent forms be kept for a minimum of 10 years. If the PI does not wish to store the data long term it may be submitted to the IRB on a CD.

#### Consent

28. **When appropriate, the research plan is required to make adequate provisions for monitoring the data to ensure safety of subjects.** Data monitoring allows the investigator to determine mid-research if:
- there is a need to change the research design or information presented to subjects
  - there are any unforeseen risks to subjects
  - there is a change in the the risks-benefit ratio
- If it is appropriate for your research data to be monitored, describe your plan to monitor the data.
29. **Are you requesting one of the following consent waivers?** Investigators are required to obtain and document consent except when waived in accordance with 32 CFR 219.116-117. Check the appropriate box to request one or more waivers and submit the applicable waiver request form.
30. **Will you request to quote subjects?** Investigators may not quote subjects without their permission and only after all quotes have been reviewed and approved by the subject.
31. **Describe the consent process and how the potential for coercion or undue influence will be minimized.** Consent is a process not a document. Include the following:
- Who is responsible for obtaining consent?
  - When will subjects be provided with the consent form?
  - Will they have time to review, consider, and ask questions about the research?
  - Where will the consent process take place?
  - When will consent be obtained?
  - How is consent obtained (i.e., in person, over the phone, email, fax, etc.)?

### Initial Review Application Package Checklist

Before submitting your application package please ensure you included the following. Only complete packages will be reviewed. Submit complete packages to Rikki Nguyen at [rapanis@nps.edu](mailto:rapanis@nps.edu) or in HA-206.

Yes	No	NA	Item
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Scientific review form signed by your department chair (in GSBPP the Dean signs).
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Conflict of interest disclosure form signed by each member of the research team.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Copy of CITI ethics training certificates for each member of the research team. For information on CITI training see below.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Consent and/or consent waiver form(s) completed and attached.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	All data collection tools are attached (survey, interview questions/script, etc.) are attached.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Recruitment materials (scripts, e-mails, flyers, presentations, URLs, etc.) are attached.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Copy of the approved thesis or research proposal (student or funded research) is attached.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If subjects are from another command, institution, or agency, attach approval or evidence approval is being sought from host organization.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ensure all forms are signed and dated.

### CITI Ethics Training for Research with Human Subjects

Registering for curriculum titled "Investigators and Key Research Personnel"

#### Who is required to complete this training?

This training is required for all those who conduct, approve, monitor, support, manage, supervise, and/or advise research with human subjects (SECNAVINST 3900.39D 6.(2)). The training is valid for three years. Please submit copies of training completion reports with your IRB application package.

#### Registration Instructions:

- Go to the CITI website [www.citiprogram.org](http://www.citiprogram.org)
- Click on "New Users Register Here"
- Complete Registration steps 1- 7.  
Your participating institution is "Department of the Navy"  
When finished click "submit."
- Enter Personal Information.  
Your command is "Naval Postgraduate School."  
When finished click "submit."
- When asked "What kinds of research are you conducting?"  
Select: "I am conducting, planning to conduct, or I am otherwise involved in research with human subjects, tissues from humans and/or patient records."
- When asked "What is your research focus?"  
Select: "Social Behavioral Science."
- When asked "Are you taking the "Initial" or "Refresher" training for Social and Behavioral Sciences?"  
Select: "Initial"
- When asked, "What is your role in social and behavior research?"  
Select: "Investigator and Key Research Personnel"
- When asked "Are you required to complete the CITI Good Clinical Practice Course?"  
Select "No."
- When asked "Do you want to review the IRB Reference Resource materials?"  
Select "No. Not at this time"
- When asked if you want to "register with another institution?"  
Select "No."
- Your new course titled "Investigators and Key Research Personnel" will now show. To start the course click "Enter."

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## **APPENDIX B. RECRUITMENT EMAIL**

Good morning,

You are receiving this email to solicit your interest in volunteering for an experiment in support of a research thesis at the Naval Postgraduate School. The aim of the thesis is to identify if the way a problem is framed affects an individual's psychological perception of thinking style balance (between linear and nonlinear).

Your participation is strictly voluntary, and would entail approximately thirty minutes of your time. If you volunteer, you will be asked to complete a short survey and problem-solving vignette. There will be no personal identification data collected, and your responses will remain anonymous. While there is no direct benefit or incentives for participating in this research, your participation will help to further the understanding of thinking style balance in decision-making.

If you would like to volunteer, please contact the undersigned via email to coordinate a time and location for your participation.

If you have questions regarding the research, please contact Dr. Leo Blanken, [ljblanke@nps.edu](mailto:ljblanke@nps.edu), Principal-Investigator. If you have any questions regarding your rights as a research subject, please contact the Naval Postgraduate School IRB Chair, Dr. Larry Shattuck, 831.656.2473, [lgshattu@nps.edu](mailto:lgshattu@nps.edu).

M.H. Laplante  
Major, Canadian Forces  
Defence Analysis Student  
Naval Postgraduate School  
[mlaplant@nps.edu](mailto:mlaplant@nps.edu)  
831-205-9539

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## **APPENDIX C. CONSENT FORM**

You are invited to participate in a research study at the Naval Postgraduate School to measure your linear/nonlinear thinking style balance. The purpose of the research is to better understand how the framing of a problem impacts an individual's psychological perception of thinking style. Your participation should take about 30 minutes to complete.

You will be asked to complete a survey, read a vignette, solve a problem, and complete a second survey. No tangible compensation or incentives are provided for your participation.

Your participation is voluntary. If you participate, you are free to skip any questions or stop participating at anytime without penalty. The alternative to participating in the research is to not participate.

Your responses are anonymous and will not be linked to your identity in any way. No personally identifying information will be collected – the survey only asks for broad demographic information and no other identifiers from participants. Any information that is obtained during this study will be kept confidential to the full extent permitted by law. All efforts, within reason, will be made to keep your personal information in your research record confidential but total confidentiality cannot be guaranteed.

The anticipated benefit from this study is that the findings will contribute to a larger body of knowledge, and can be used to optimize military problem solving. You will not directly benefit from your participation in this research.

There are minimal risks associated with participation. Results of the survey will be used responsibly and protected against release to unauthorized persons; however, there is a minor risk that data collected could be mismanaged. Only the researchers will have access to the data, which will be stored on a password-protected computer.

If you have questions regarding the research, or if you experience any injury or discomfort, contact Dr. Leo Blanken, [ljblanken@nps.edu](mailto:ljblanken@nps.edu), Principal-Investigator. If you

have any questions regarding your rights as a research subject, please contact the Naval Postgraduate School IRB Chair, Dr. Larry Shattuck, 831.656.2473, lgshattu@nps.edu.

Statement of Consent

I have read the information provided above. I have been given the opportunity to ask questions and all the questions have been answered to my satisfaction. I agree to participate in this study. I understand that by agreeing to participate in this research and checking the box below, I do not waive any of my legal rights.

- ☐ I consent to participate in the research study.
- ☐ I do not consent to participate in the research study.

Please print full name and sign below:

_____	_____	_____
Print Name	Signature	Date

## APPENDIX D. LNMTSA

### Linear/Nonlinear Multidimensional Thinking Style Assessment (LNMTSA) Instrument

#### Part 1

	Strongly Disagree Agree	Strongly Disagree	Neutral	Agree	
1. I prefer to solve problems using nontraditional methods.	1	2	3	4	5
2. I primarily rely on logic when making important decisions.	1	2	3	4	5
3. Whenever considering competing options, I tend to go with the option that is most consistent with my core values.	1	2	3	4	5
4. I tend to alter my decision-making style according to the demands of the specific situation.	1	2	3	4	5
5. When making decisions about issues with which I am very familiar, I often rely on my intuition rather than quantifiable, objective evidence.	1	2	3	4	5
6. When preparing for an important task, I often mentally rehearse the major steps involved.	1	2	3	4	5
7. Some of my best ideas just pop into my mind at unexpected moments.	1	2	3	4	5
8. When in conflict with someone who doesn't agree with my logical argument, I usually can recognize when the person's underlying feelings are causing the conflict.	1	2	3	4	5
9. I like to consider new ways of doing things rather than remaining with the same familiar way.	1	2	3	4	5
10. My understanding of a problem tends to come more from rational analysis than my intuition.	1	2	3	4	5
11. I am inclined to use unconventional approaches to solving problems.	1	2	3	4	5
12. My dissatisfaction with a situation keeps me working toward a satisfactory solution.	1	2	3	4	5
13. I tend to make important decisions based on my inner sense or intuition.	1	2	3	4	5
14. When making important decisions, I consider my personal principles as much as facts, figures, and other data.	1	2	3	4	5
15. When I don't arrive at an immediate answer to a difficult problem, I often put the problem aside to return to it at another time.	1	2	3	4	5
16. I primarily rely on my intuition when making career decisions.	1	2	3	4	5



17. To solve a complex problem, I am willing to consider different approaches to solving the problem.	1	2	3	4	5
18. I use metaphors to enhance my logical understanding of difficult challenges.	1	2	3	4	5
19. I am at my best in challenging situations that require rational problem solving.	1	2	3	4	5
20. When I am unable to come to a satisfactory answer to a problem, I often let it go for a while, and later the solution often suddenly presents itself when it is least expected.	1	2	3	4	5
21. My perception of others' emotions often helps me determine an appropriate way to interact with them.	1	2	3	4	5
22. My core values are just as important for making decisions as logical analysis.	1	2	3	4	5
23. Most people would describe me as flexible when it comes to adopting various approaches to solving problems.	1	2	3	4	5
24. To help maintain my motivation, I like to visualize the successful completion of a project I am working on.	1	2	3	4	5

## **Part 2**

	Strongly Disagree Agree	Strongly Disagree	Neutral	Agree	
25. Compared to most people, I often use other approaches to problem solving than those that are "tried and true."	1	2	3	4	5
26. I primarily weigh my intuition when making a decision about a major purchase.	1	2	3	4	5
27. I often sense my rising emotions before they can interfere with my thinking about a problem.	1	2	3	4	5
28. I most enjoy work that allows me to use my logical reasoning.	1	2	3	4	5
29. When confronted with an important decision, I allow my feelings to influence my decision.	1	2	3	4	5
30. When I start a project, I find it helpful to visualize the desired outcome of the project.	1	2	3	4	5
31. I can easily adjust my approach to solving problems.	1	2	3	4	5
32. When facing a complex problem with conflicting points of view, my values provide me a sense of direction.	1	2	3	4	5
33. I sometimes get new ideas or solutions to problems from completely unexpected or unrelated sources.	1	2	3	4	5
34. When my logical reasoning and feelings are in conflict, I tend to favor my logical reasoning.	1	2	3	4	5
35. To fully understand a complex problem, I consider hard facts as well as my gut feelings.	1	2	3	4	5
36. Much of my beneficial learning comes from insights gained in the course of everyday experiences.	1	2	3	4	5
37. I am at my best in challenging situations that require creative problem solving.	1	2	3	4	5
38. I have found that creating images helps me better understand complex problems.	1	2	3	4	5
39. I prefer to let my personal principles guide my decision making.	1	2	3	4	5
40. When I meet with others to make a group decision, I encourage a friendly atmosphere to support effective collaboration.	1	2	3	4	5
41. I much prefer working on problems that require a logical, step-by-step approach.	1	2	3	4	5
42. When possible, I prefer to break out of routine behavior and activities.	1	2	3	4	5
43. In a volatile and changing environment, my values provide me a sense of stability in making important decisions.	1	2	3	4	5
44. I sometimes make decisions based on an inner certainty that is difficult to explain to others.	1	2	3	4	5
45. My understanding of a problem tends to come more from sudden bursts of insight rather than systematic analysis.	1	2	3	4	5

	Strongly Disagree Agree	Strongly Disagree	Neutral	Agree	
46. I often prioritize my work tasks according to how strongly I feel about the importance of each task.	1	2	3	4	5
47. When working to solve a problem, I try to examine it in new and different ways to come to an optimal solution.	1	2	3	4	5
48. I often imagine a positive outcome when preparing for an upcoming stressful meeting or event.	1	2	3	4	5

**Scoring:**

Questions 1–24

A. Add responses on items 2, 10, 19 and divide by 3 (highest possible linear score is 5, lowest possible is 1).

Score: \_\_\_\_\_

B. Add responses on all the other items and divide by 21 (highest possible nonlinear score is 5).

Score: \_\_\_\_\_

Overall Thinking Style Score: Subtract your score in B above from your score in A.

\_\_\_\_\_

CT (Creative Thinking) Score: Add your score for items 1, 9, 11: \_\_\_\_\_

VCT (Values-Centered Thinking) Score: Add your score for items 3, 14, 22: \_\_\_\_\_

INTT (Intuitive Thinking) Score: Add your score for items 5, 13, 16: \_\_\_\_\_

INS (Insightful Thinking) Score: Add your score for items 7, 15, 20: \_\_\_\_\_

ET (Emotional Thinking) Score: Add your score for items 8, 12, 21: \_\_\_\_\_

FT (Flexible Thinking) Score: Add your score for items 4, 17, 23: \_\_\_\_\_

IMT (Imaginative Thinking) Score: Add your score for items 6, 18, 24: \_\_\_\_\_

Questions 25–48

A. Add responses on items 28, 34, 41 and divide by 3 (highest possible linear score is 5, lowest possible is 1).

Score: \_\_\_\_\_

B. Add responses on all the other items and divide by 21 (highest possible nonlinear score is 5).

Score: \_\_\_\_\_

Overall Thinking Style Score: Subtract your score in B above from your score in A.  
\_\_\_\_\_

CT (Creative Thinking) Score: Add your score for items 25, 37, 42: \_\_\_\_\_

VCT (Values-Centered Thinking) Score: Add your score for items 32, 39, 43: \_\_\_\_\_

INTT (Intuitive Thinking) Score: Add your score for items 26, 29, 44: \_\_\_\_\_

INS (Insightful Thinking) Score: Add your score for items 33, 36, 45: \_\_\_\_\_

ET (Emotional Thinking) Score: Add your score for items 27, 40, 46: \_\_\_\_\_

FT (Flexible Thinking) Score: Add your score for items 31, 35, 47: \_\_\_\_\_

IMT (Imaginative Thinking) Score: Add your score for items 30, 38, 48: \_\_\_\_\_

## APPENDIX E. EXPERIMENT VIGNETTE

You are one of four company commanders in a battalion size unit that is preparing for an upcoming deployment. Given the proposed area of operations and other competing missions, your commander expects that he will not receive unmanned aircraft system (UAS) support that would typically be provided. He is reluctant to conduct the mission without UAS support due to the increased risk to force and decreased situational awareness in his operations center. Your commander has decided that an integral UAS capability within the battalion is the only way to ensure some level of UAS coverage for the upcoming mission. He also believes that a lack of external UAS support will continue in the coming years. Your commander has tasked you with standing up this new capability within your company. In order to force generate the required UAS personnel to man this new capability, he has authorized you to draw 15 NCOs from the other three companies to be employed outside their MOS.

**Your immediate task is to develop a course of action to select the most suitable individuals.** Your commander stresses that given the autonomy and technical complexity of this capability, the prospective operators must have well above average cognitive abilities.

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## **APPENDIX F. EXPERIMENT TREATMENTS**

Your commanding officer called you into his office and provided the following guidance:

### **A. CONTROL GROUP COMMANDER'S GUIDANCE**

You are familiar with my expectations and decision-making process. Proceed with the task of selecting 15 NCOs for this new capability.

### **B. LINEAR GROUP COMMANDER'S GUIDANCE**

You are familiar with my expectations and decision-making process. Proceed with the task of selecting 15 NCOs for this new capability. You know I like to see logic laid out in a step-by-step methodical process that follows our established doctrinal guidelines and unit SOPs. As always, I want to see your mission analysis as it will increase the confidence of my decision. Brief me weekly on your progress and keep me abreast of any issues you encounter.

### **C. BALANCED GROUP COMMANDER'S GUIDANCE**

You are familiar with my expectations and decision-making process. Proceed with the task of selecting 15 NCOs for this new capability. Use existing unit doctrine and standard operating procedures as a departure point, but do not hesitate to include creative options for completing the task. I encourage you to collaborate with your peers to develop an innovative course of action. Brief me when the task is complete.



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## **APPENDIX G. DEBRIEF SCRIPT**

Thank you for your participation in this research study at the Naval Postgraduate School. Your participation will directly contribute to the body of knowledge on thinking style balance in military decision making.

It must be made clear that there are no correct or incorrect responses to the problem-solving vignette or survey questions. Furthermore, there is no identified link between an officer's thinking style balance and future performance or potential.

If you have questions regarding the research, or if you experience any injury or discomfort, contact Dr. Leo Blanken, [ljblanke@nps.edu](mailto:ljblanke@nps.edu), Principal-Investigator. If you have any questions regarding your rights as a research subject, please contact the Naval Postgraduate School IRB Chair, Dr. Larry Shattuck, 831.656.2473, [lgshattu@nps.edu](mailto:lgshattu@nps.edu).

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